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NORTH AMERICAN DRÄGER

Operator's Instruction Manual

VITALERT 2000/2000E
Vital Signs Monitoring System

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VITALERT 2000
OPERATOR'S INSTRUCTION MANUAL

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FOREWORD

OPERATOR'S RESPONSIBILITY FOR PATIENT SAFETY

North American Dräger anesthesia products are designed to provide the greatest degree of patient safety that is practically and technologically feasible. The design of the equipment, the accompanying literature, and the labeling on the equipment take into consideration that the purchase and use of the equipment are restricted to trained professionals, and that certain inherent characteristics of the equipment are known to the trained operator. Instructions, warnings, and caution statements are limited, therefore, to the specifics of the North American Dräger design. This publication excludes references to hazards which are obvious to a medical professional, to the consequences of product misuse, and to potentially adverse effects in patients with abnormal conditions. Product modification or misuse can be dangerous. North American Dräger disclaims all liability for the consequences of product alterations or modifications, as well as for the consequences which might result from the combination of North American Dräger products with products supplied by other manufacturers if such a combination is not endorsed by North American Dräger.

The operator of the anesthesia system must recognize that the means of monitoring and discovering hazardous conditions are specific to the composition of the system and the various components of the system. It is the operator, and not the various manufacturers or suppliers of components, who has control over the final composition and arrangement of the anesthesia system used in the operating room. Therefore, the responsibility for choosing the appropriate safety monitoring devices rests with the operator and user of the equipment.

Patient safety may be achieved through a variety of different means depending on the institutional procedures, the preference of the operators, and the application of the system. These means range from electronic surveillance of equipment performance and patient condition to simple, direct contact between operator and patient (direct observation of clinical signs). The responsibility for the selection of the best level of patient monitoring belongs solely to the equipment operator. To this extent, the manufacturer, North American Dräger, disclaims responsibility for the adequacy of the monitoring package selected for use with the anesthesia system. However, North American Dräger is available for consultation to discuss monitoring options for different applications.

LIMITATION OF LIABILITY

North American Dräger's liability, whether arising from or related to manufacture and sale of the goods, their installation, demonstration, sales representation, use,performance, or otherwise, including any liability based upon North American Dräger's Product Warranty, is subject to and limited to the exclusive terms and conditions as set forth, whether based upon breach of warranty or any other cause of action whatsoever, regardless of any fault attributable to North American Dräger and regardless of the form of action (including, without limitation, breach of warranty, negligence, strict liability, or otherwise).

THE STATED EXPRESSED WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY, FITNESS FOR ANY PARTICULAR PURPOSE, OR NONINFRINGEMENT.

LIMITATION OF LIABILITY (continued)

North American Dräger shall not be liable for, nor shall buyer be entitled to recover any special incidental, or consequential damages or for any liability incurred by buyer to any third party in any way arising out of or relating to the goods.

WARRANTY

All North American Dräger products are guaranteed to be free of defects for a period of one year from date of delivery. The following are exceptions to this warranty:

1. The defect shall be a result of workmanship or material. Defects caused by misuse, mishandling, tampering, or by modifications not authorized by North American Dräger or its representatives are not covered.

2. Rubber and plastic components and materials are warranted to be free of defects at time of delivery.

3. SPIROMED sensors, oxygen sensors, and the MINUTE VOLUMETER have a six-month limited warranty. O_2MED sensor capsules have an eight-month limited warranty from the date of delivery.

4. Warranty for Durasensors is limited to a period of six months from the date of delivery. Oxisensors are warranted to be free of defects at time of delivery.

Any product which proves to be defective in workmanship or material will be replaced, credited, or repaired with North American Dräger holding the option. North American Dräger is not responsible for deterioration, wear, or abuse. In any case, North American Dräger will not be liable beyond the original selling price.

Application of this warranty is subject to the following conditions:

1. North American Dräger or its authorized representative must be promptly notified, in writing, upon detection of the defective material or equipment.

2. Defective material or equipment must be returned, shipping prepaid, to North American Dräger or its authorized representative.

3. Examination by North American Dräger or its authorized representative must confirm that the defect is covered by the terms of this warranty.

4. Notification in writing, of defective material or equipment must be received by North American Dräger or its authorized representative no later than two (2) weeks following expiration of this warranty.

In order to assure complete protection under this warranty, the Warranty-Registration card and/or Periodic Manufacturers Service record (if applicable) must be returned to North American Dräger within ten (10) days of receipt of the equipment.

The above is the sole warranty provided by North American Dräger. No other warranty expressed or implied is intended. Representatives of North American Dräger are not authorized to modify the terms of this warranty.

REPAIR AND SERVICE

In case of malfunction of this device, contact your local North American Dräger Factory Authorized Technical Service Center.

North American Dräger recommends that anesthesia machines be serviced at three month intervals. Periodic Manufacturers Service Contracts are available for products manufactured by North American Dräger. These agreements are available from N.A.D., Inc. Technical Service Department or our Factory Authorized Technical Service Center.

Repair of the VITALERT 2000 shall be performed only by a North American Dräger authorized technical service representative.

TERMS AND CONDITIONS

All merchandise to be returned must have prior written authorization by North American Dräger, and a valid Return Authorization Number must appear on the shipping label, packing slip, purchase order and any other related paperwork. Goods received without such authorization will be refused at NAD's receiving dock and returned to the customer.

When requesting authorization to return merchandise, the following information must be provided:

1. Customer purchase order and date
2. NAD order number, shipping date, and method of shipment (available from packing slip)
3. Invoice date and number
4. Quantity, NAD product number, and description of merchandise to be returned
5. Reason for return

The following are accepted reasons for return of merchandise:

1. Defective goods
2. Customer order error
3. NAD order/shipping error

Any shortages or errors in shipment of goods must be reported to NAD within two (2) weeks of shipment in order for corrective action to be taken.

Goods are subject to the terms of any applicable warranty. Defective products will be accepted for return at North American Dräger's discretion, and only during the warranty period.

Goods to be returned which are not under warranty must have been purchased within thirty days of request for return, and returned within thirty days after request. Products must be returned unused, and in NAD shipping containers. Goods are subject to a 20% restocking charge, with the exception of defective goods or NAD error. The decision regarding restocking charges remains solely at North American Dräger's discretion, and is final.

The following lists merchandise not eligible for return, unless proven defective:

1. Specially ordered or produced items
2. Sterile or rubber goods
3. Used merchandise, or products not in original shipping container
4. Merchandise held over thirty days from shipment by North American Dräger
5. Merchandise which has been altered or abused in any way

Upon receipt of authorized returned goods an inspection of the merchandise will be conducted and appropriate action taken. North American Dräger's decision regarding disposition of returned goods is final.

TERMS AND CONDITIONS (continued)

All items to be returned should be shipped prepaid to:

North American Dräger
148 B Quarry Road
Telford, PA 18969
ATTN: Customer Service Department
(Include Return Authorization Number)

Factory Repair:
North American Dräger products in need of factory repair should be sent prepaid to:

North American Dräger
24 Commerce Drive
Telford, PA 18969
(Include Return Authorization Number)

Periodic Manufacturer's Service:
Yearly Periodic Manufacturers Service Contracts are available for products manufactured by North American Dräger. These agreements are available from the Technical Service Department or our Nationwide Factory Authorized Technical Service Centers.

Any product which proves to be defective in workmanship or material will be replaced, credited, or repaired with North American Dräger holding the option. North American Dräger is not responsible for deterioration, wear, or abuse. In any case, North American Dräger will not be liable beyond the original selling price.

Application of this warranty is subject to the following conditions.

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2. Defective material or equipment must be returned, shipping prepaid, to North American Dräger or its authorized representative.

3. Examination by North American Dräger or its authorized representative must confirm that the defect is covered by the terms of this warranty.

4. Notification in writing, of defective material or equipment must be received by North American Dräger or its authorized representative no later than two (2) weeks following expiration of this warranty.

In order to assure complete protection under this warranty, the Warranty-Registration Card and/or Periodic Manufacturers Service record (if applicable) must be returned to North American Dräger within ten (10) days of receipt of the equipment.

The above is the sole warranty provided by North American Dräger. No other warranty expressed or implied is intended. Representatives of North American Dräger are not authorized to modify the terms of this warranty.

RESTRICTION

Federal law restricts this device to sale by, or on the order of, a physician.

GENERAL DESCRIPTION

The VITALERT 2000 is a vital signs monitoring package designed to be an integral part of an operating room anesthesia system. The VITALERT 2000 can be used to monitor a patient's electrocardiogram (ECG), invasive blood pressure, and temperature.

A display screen is provided for presentation of waveforms, data, and structured alarms.

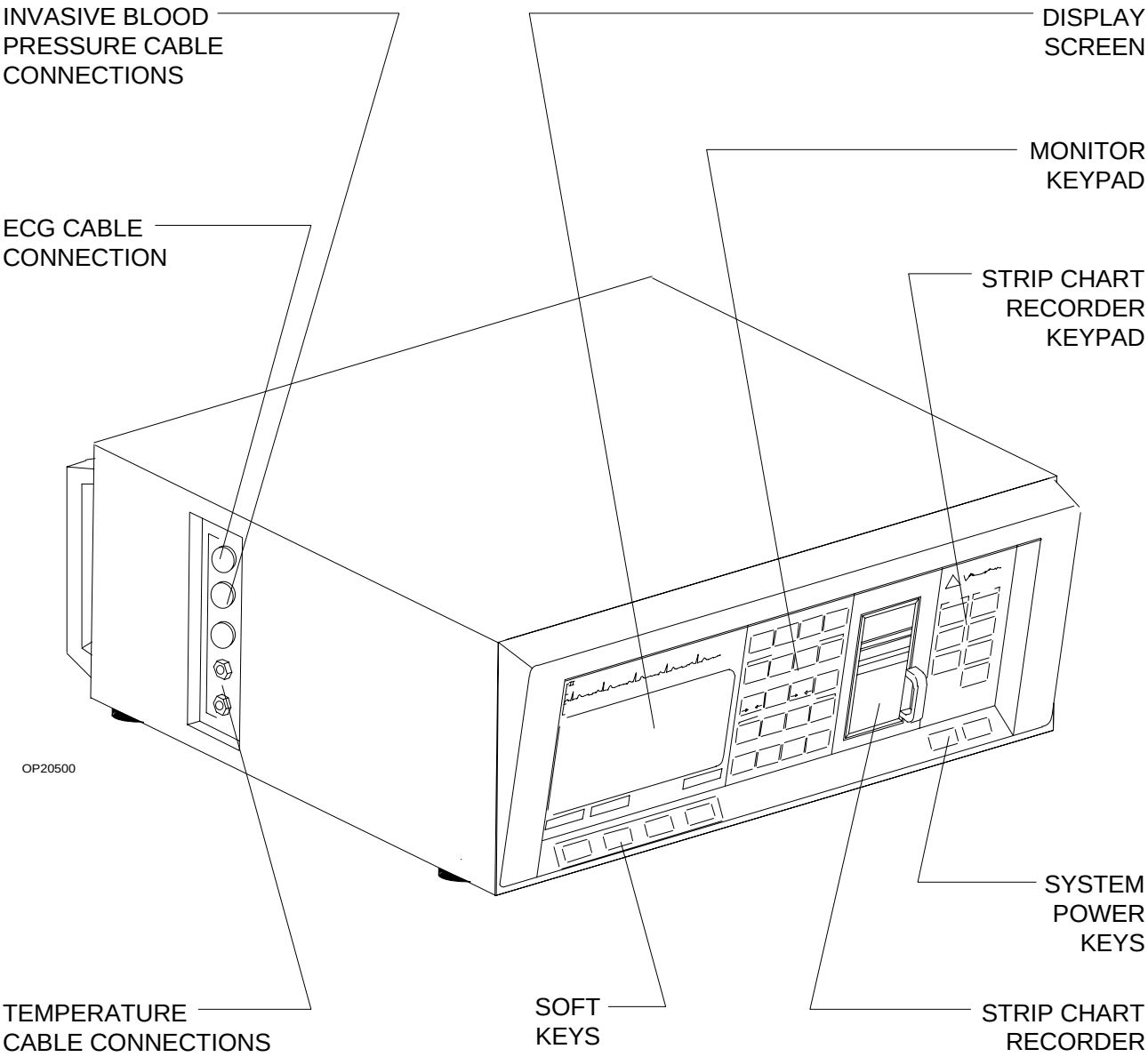

FIGURE 1: VITALERT 2000 (FRONT VIEW)

GENERAL DESCRIPTION (continued)

The styling and communications protocol of the VITALERT 2000 are consistent with NAD anesthesia systems, incorporating the interconnection of data and the centralization of alarms.

The VITALERT 2000 features self-diagnostics and automatic reserve battery power during AC power failure.

The VITALERT 2000 also utilizes a built-in strip chart recorder to make hard copy records of on-screen information.

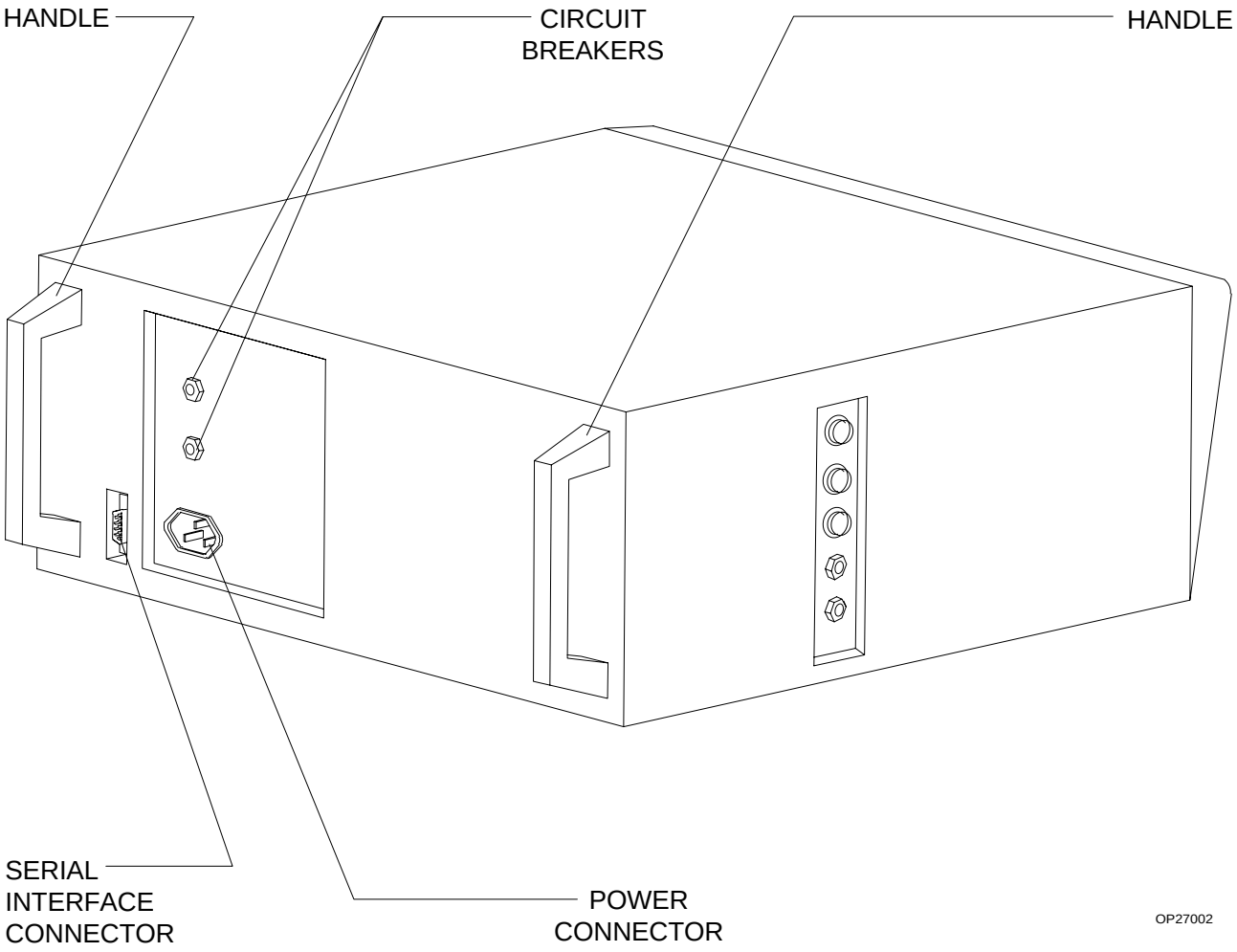

FIGURE 2: VITALERT 2000 (REAR VIEW)

FEATURES

This section provides an overview of the VITALERT 2000 functions and capabilities. Detailed descriptions appear in subsequent sections of this manual. Refer to Figure 1 for an illustration of the VITALERT 2000 front panel.

Monitoring Display

The VITALERT 2000 features a 7-inch diagonal amber CRT for the display of waveforms, data, and alarm messages. The keys which affect the monitoring display are arranged in specific groups to the right of the display screen. Four soft keys beneath the monitoring display are used to manipulate on-screen data.

Alarm Display and Annunciation

The VITALERT 2000 presents active alarms at the bottom of the CRT in a three-level display of Warnings, Cautions, and Advisories. Any alarms generated are indicated by a 12 character keyword phrase in the appropriate category.

When operating as a stand-alone monitor, the VITALERT 2000 uses non-obtrusive sound patterns to annunciate active alarms. These easily distinguished patterns coincide with the NAD alarm priority classification of Warnings, Cautions, and Advisories. The VITALERT 2000 will only annunciate the highest priority currently active alarm. Lower priority alarm sounds are temporarily suppressed to minimize the confusion and nuisance caused by simultaneous alarms. When interfaced to a host system such as NARKOMED 3, NARKOMED 2B or VITALERT 1000, VITALERT 2000 audio alarms are disabled; the alarm condition is annunciated through the host system.

Monitor Screen

The Monitor screen (Figure 3) presents graphic and numerical information derived from the ECG lead, the invasive blood pressure transducers and the temperature probes. The Monitor screen is organized into six areas: the ECG display, the P1 Arterial Blood Pressure display, the P2 Blood Pressure display, the T1 Temperature display, the T2 Temperature display, and the Alarm display.

ECG Display

The VITALERT 2000 can monitor three standard bipolar ECG limb leads (I, II, III), three augmented leads (aVR, aVL, aVF), and a floating chest lead (V). The ECG display contains:

- ECG waveform
- Heart Rate
- Heart Rate Alarm Limits
- Selected ECG Lead
- ECG Scale with 1 mV Markings
- Isoelectric Line Reference (with reference digits at the top and bottom to indicate mV's from isoelectric).
- Flashing Heart Indicator (if selected).

Invasive Blood Pressure Display

The VITALERT 2000 can monitor two channels of invasive blood pressure. The P1 Pressure display is labeled for arterial pressure (P1 ART). The P2 Pressure display can be labeled for either central venous pressure (P2 CVP), pulmonary artery pressure (P2 PA), or as a second arterial pressure channel (P2 ART).

FEATURES (continued)

The P1 display, located beneath the ECG display, contains:

- P1 Label (P1 ART)
- P1 Arterial Pressure Waveform
- Pressure Scale (mm Hg)
- P1 Arterial Systolic Pressure
- P1 Arterial Mean Pressure
- P1 Arterial Diastolic Pressure
- P1 Arterial Systolic Alarm Limits

The P2 display, located beneath the P1 display, contains:

- P2 Label (P2 CVP, P2 PA, or P2 ART)
- P2 Pressure Waveform
- Pressure Scale (mm Hg)
- P2 Systolic Pressure
- P2 Diastolic Pressure
- P2 Mean Pressure
- P2 Alarm Limits (systolic, diastolic, or mean)

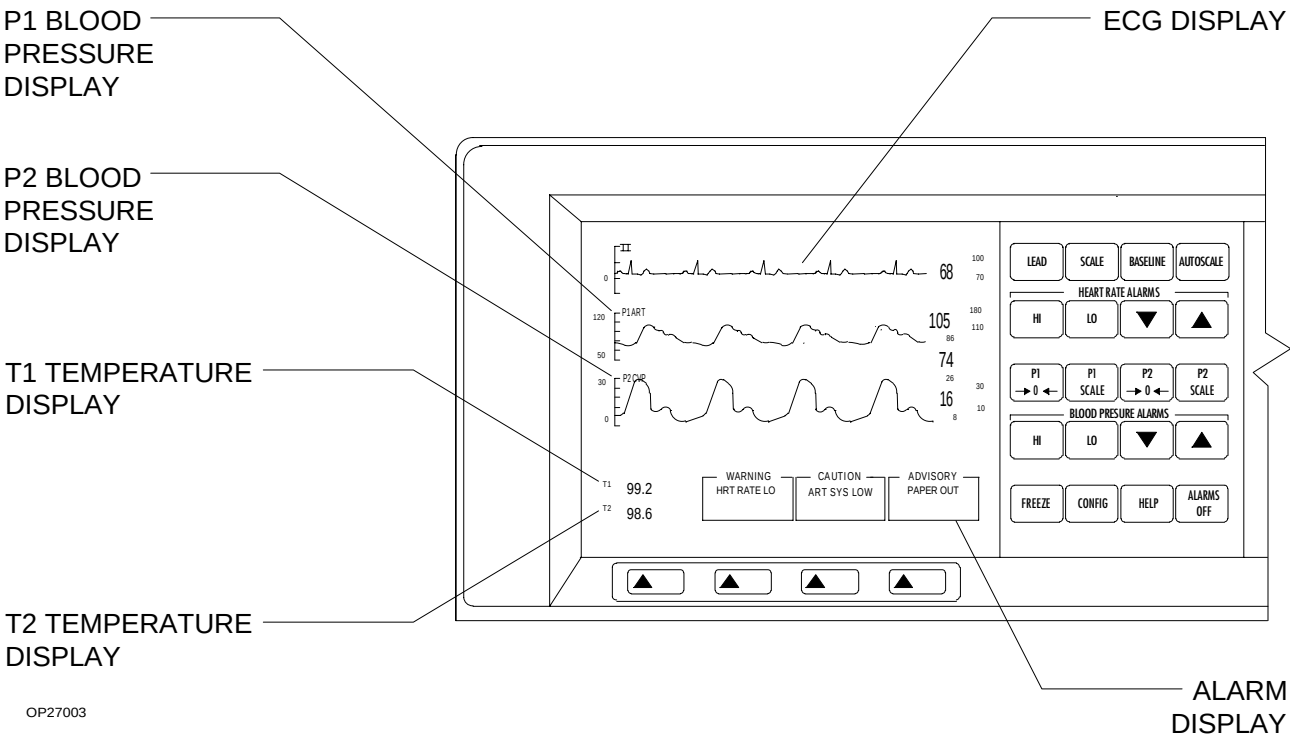

FIGURE 3: VITALERT 2000 MONITOR SCREEN

FEATURES (continued)

Temperature Display

The VITALERT 2000 can monitor two channels of temperature. These temperatures can be displayed in Celsius or Fahrenheit. The Temperature display is located at the bottom left corner of the Monitor screen.

Self-Diagnostics

When switched on, the VITALERT 2000 automatically performs extensive self-diagnostic tests on its internal circuitry. The results are posted on the display screen at the completion of each test, and the operational status of the VITALERT 2000 is indicated at the conclusion of self-diagnostics.

Configuration Screens

Six Configuration screens allow the operator to customize operation of the VITALERT 2000.

Freeze Screen

The Freeze screen allows the operator to examine a 16 second section of the ECG waveform.

Help Screens

The VITALERT 2000 incorporates a Help key to aid in the understanding of VITALERT 2000 operation.

Strip Chart Recorder

The strip chart recorder allows the operator to make hard copy records of the ECG waveform, P1 waveform, measurement data, or trends.

Back-Up Power System

In case of an AC power failure, operation of the VITALERT 2000 is maintained by an internal reserve battery.

Interface to NARKOMED 3, NARKOMED 2B or VITALERT 1000

When interfaced with the NARKOMED 3 and 2B anesthesia systems, or the VITALERT 1000 monitoring system, VITALERT 2000 alarm messages are prioritized and displayed on the systems Centralert Alarm Display. VITALERT 2000 data can be viewed on the systems Trend and Data Display screens.

INSTALLATION

Unpacking the VITALERT 2000

Remove the VITALERT 2000 and accessories from their container. Use the checklist below to verify the presence of the following articles:

- 1 VITALERT 2000 Monitor
- 1 Data Cable (DB9/DB9/30 inches)
- 1 Power Cable
- 1 ECG Monitor Cable
- 1 Invasive Blood Pressure Cable (optional)
- 1 ECG Lead Set (5 Leads)
- 1 ECG Clip
- 2 Temperature Probes-YSI Series 700
- 1 VITALERT 2000 Operators Manual
- Vitalink Technical Reference Manual
- 2 Chart Paper rolls (1 installed, 1 spare)

Installing the VITALERT 2000

The VITALERT 2000 requires about 18 x 17 inches of shelf space. The shelf should be capable of supporting at least 40 lb. without collapsing or creating a tip-over hazard. Reset circuit breakers CB1 and CB2, located on the rear of the VITALERT 2000 (Fig. 2), by pressing in the white buttons. Attach one end of the power cable to the receptacle on the rear of the VITALERT 2000 (Fig. 2). Attach the other end into an active, standard hospital-grade 115 VAC rated, grounded receptacle.

CAUTION: The VITALERT 2000 may have a leakage current of up to 30 microamps. When plugged into the convenience receptacle of another device, the VITALERT 2000 contributes to the total system chassis leakage current of that device. This total leakage current should not exceed 100 microamps.

Connecting the VITALERT 2000 to a Computer

To interface the VITALERT 2000 to a computer (with RS-232 Serial Port):

1. Connect the 9-pin end of the DB9/DB25 30-inch data cable (Part # 4109882) to the serial port on the rear of the VITALERT 2000 (Fig. 2).

2. Connect the other end of the cable to the 25-pin serial port of the computer, configured as DCE.

3. Secure all connections using the captive screws provided.

4. Configure the VITALERT 2000 serial port, via the Communication Port Configuration screen from the following parameters (see the section entitled *Configuration*):

   BAUD RATE: 1200, 2400, 4800, or 9600
   DATA BITS: 7 or 8
   PARITY: NONE, EVEN, or ODD
   STOP BITS: 1 or 2
   RTS/CTS: OFF or ON
   PROTOCOL: VITALINK

Refer to the Vitalink Technical Reference manual for software information.

Connecting the VITALERT 2000 to a VITALERT 1000

To interface the VITALERT 2000 to the VITALERT 1000 monitor:

1. Connect one end of the DB9/DB9 30-inch data cable (Part # 4110328) to the serial port on the rear of the VITALERT 2000 (Fig. 2).

2. Connect the other end of the cable to Port A on the rear of the VITALERT 1000 (see *VITALERT 1000 Operators Manual*).

3. Secure all connections using the captive screws provided.

4. Configure the VITALERT 2000 serial port, via the Communication Port Configuration screen for the following parameters:

BAUD RATE:	2400
DATA BITS:	8
PARITY:	NONE
STOP BITS:	1
RTS/CTS:	OFF
PROTOCOL:	VITALINK

5. Configure Port A of the VITALERT 1000 for the same parameters given in step 4 (see Configuration section in *VITALERT 1000 Operators Manual*).

Connecting the VITALERT 2000 to a NARKOMED 3

To interface the VITALERT 2000 to the NARKOMED 3 anesthesia system (with the five-port serial interface):

1. Connect one end of the DB9/DB9 30-inch data cable (Part # 4110328) to the serial port on the rear of the VITALERT 2000 (Fig. 2).

2. Connect the other end of the cable to Port E on the rear of the NARKOMED 3 (see *NARKOMED 3 Operators Manual*).

3. Secure all connections using the captive screws provided.

4. Configure the VITALERT 2000 serial port, via the Communication Port Configuration screen, for the following parameters:

BAUD RATE:	9600
DATA BITS:	8
PARITY:	EVEN
STOP BITS:	2
RTS/CTS:	OFF
PROTOCOL:	VITALINK

   Port E of the NARKOMED 3 automatically defaults to the configuration values outlined in Step 4.

NOTE: In order to ensure the proper operation of Vitalink communications, the following firmware versions (or later) should be present on the Narkomed 3: Trend 1.04, Serial IF (ECC) 1.02, CCC 1.07.

Connecting the VITALERT 2000 to a NARKOMED 2B

To interface the VITALERT 2000 to the NARKOMED 2B anesthesia system:

1. Connect one end of the DB9/DB9 30-inch data cable (Part # 4110328) to the serial port on the rear of the VITALERT 2000 (Fig. 2).

2. Connect the other end of the cable to Port A on the rear of the NARKOMED 2B (see *NARKOMED 2B Operators Manual*).

3. Secure all connections using the captive screws provided.

4. Configure the VITALERT 2000 serial port, via the Communication Port Configuration screen, for the following parameters:

BAUD RATE:	1200
DATA BITS:	8
PARITY:	NONE
STOP BITS:	1
RTS/CTS:	OFF
PROTOCOL:	VITALINK

5. Configure Port A of the NARKOMED 2B for the same parameters given in step 4 (see Configuration section in *NARKOMED 2B Operators Manual*).

INSTALLATION (continued)

Connecting the VITALERT 2000 to a NARKOMED 4

To interface the VITALERT 2000 to the NARKOMED 4 anesthesia system:

1. Connect one end of the DB9/DB9 30-inch data cable (Part # 4110328) to the serial port on the rear of the VITALERT 2000 (Fig. 2).

2. Connect the other end of the cable to either Port C or Port D on the rear of the NARKOMED 4 (see *NARKOMED 4 Operator's Manual*).

3. Secure all connections using the captive screws provided.

4. Configure the VITALERT 2000 serial port, via the Communication Port Configuration screen, for the following parameters:

BAUD RATE:	9600
DATA BITS:	8
PARITY:	NONE
STOP BITS:	1
RTS/CTS:	ON
PROTOCOL:	VITALINK

5. Configure Port C or D of the NARKOMED 4 for the same parameters given in step 4 (see Configuration section in *NARKOMED 4 Operator's Manual*).

   NOTE: There is no RTS/CTS setting with the NARKOMED 4.

Connecting the VITALERT 2000 to a NARKOMED 2C

To interface the VITALERT 2000 to the NARKOMED 2C anesthesia system:

1. Connect one end of the DB9/DB9 30-inch data cable (Part # 4110328) to the serial port on the rear of the VITALERT 2000 (Fig. 2).

2. Connect the other end of the cable to either Port A or Port B on the rear of the NARKOMED 2C (see *NARKOMED 2C Operator's Manual*).

3. Secure all connections using the captive screws provided.

4. Configure the VITALERT 2000 serial port, via the Communication Port Configuration screen, for the following parameters:

BAUD RATE:	9600
DATA BITS:	8
PARITY:	NONE
STOP BITS:	1
RTS/CTS:	ON
PROTOCOL:	VITALINK

5. Configure Port A or B of the NARKOMED 2C for the same parameters given in step 4 (see Configuration section in *NARKOMED 2C Operator's Manual*).

   NOTE: There is no RTS/CTS setting with the NARKOMED 2C.

CONFIGURATION

Several aspects of the VITALERT 2000 operation can be configured by the user. Pressing the CONFIG key (in the bottom row of the monitor keypad) invokes the Configuration Menu (Fig. 4).

The Configuration Menu allows the operator to select one of six configuration screens:

- Monitoring Options
- Audio Adjustments
- Set Alarm Limits
- Auto Print and Auto Plot
- Communication Port
- Set Time and Date

The operator chooses a specific configuration screen by pressing the soft key labeled
SELECT to advance the cursor to the corresponding screen label on the menu, then pressing the ENTER soft key. After a screen is selected, the operator can change configurable VITALERT 2000 functions with the labeled soft keys beneath the display.

NOTE: While in the Configuration mode, the VITALERT 2000 continues to monitor alarm conditions. The VITALERT 2000 automatically returns to the Monitor screen one minute following the last keystroke in the Configuration mode.

All settings and selections of the Configuration mode, unless otherwise specified, are retained in memory when the VITALERT 2000 is turned off.

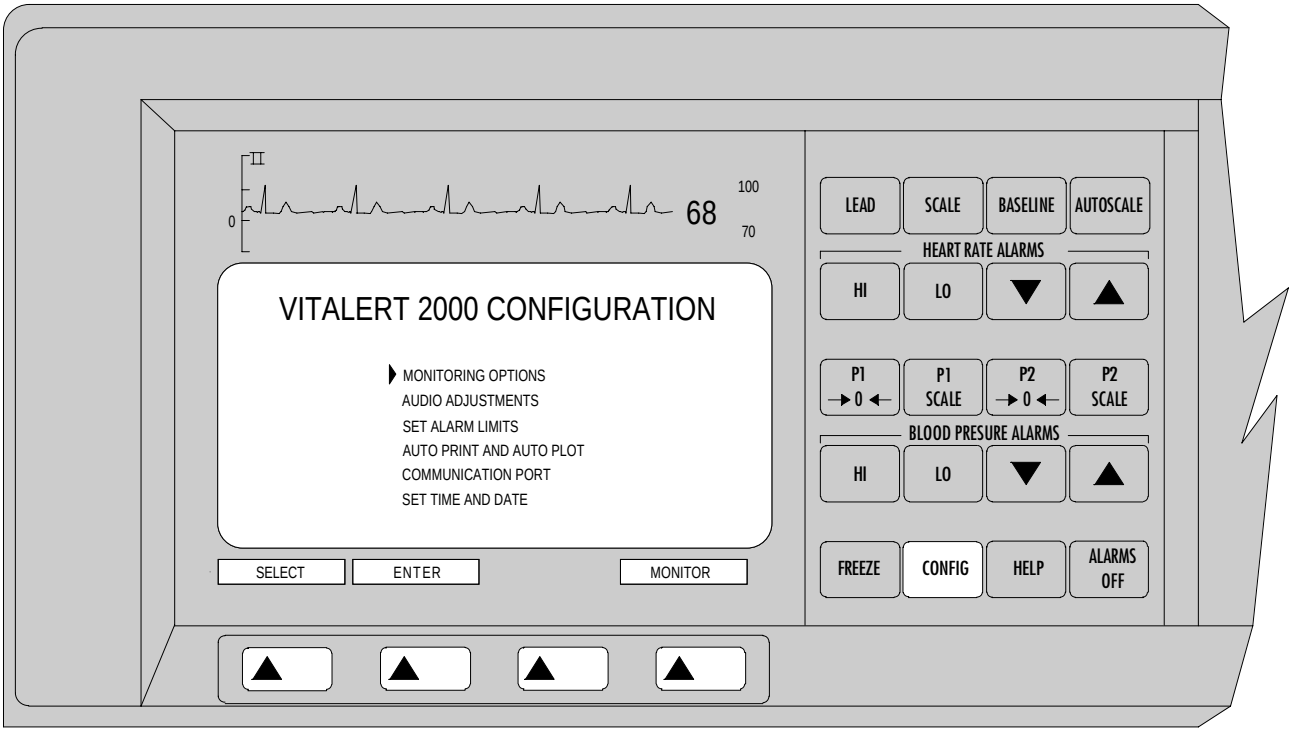

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FIGURE 4: CONFIGURATION MENU

VITALERT 2000 Monitoring Configuration

The Monitoring Options screen (Fig. 5) controls how information is presented on the Monitor screen.

Flashing Heart

The first option, Flashing Heart, activates a flashing heart on the monitor screen as a visual representation of R-wave detection.

P2 Label

The P2 Label option selects one of three labels for the P2 pressure channel (P2 CVP, P2 PA, or P2 ART).

Trace Speed

Trace Speed selects the sweep rate of the waveforms. The sweep rate can be configured for either 12.5 mm/sec, 25 mm/sec, or 50 mm/sec. On power-up, the sweep rate defaults to 25 mm/sec.

P1 Scale

The P1 Scale option configures the P1 SCALE key for manual or automatic pressure waveform scale selection. See the Operating Instructions section of this manual for more information.

P2 Scale

The P2 Scale option configures the P2 SCALE key for manual or automatic pressure waveform scale selection. See the Operating Instructions section of this manual for more information.

Temperature Units

Selecting Temperature Units allows the operator to display the measured temperature in either Fahrenheit or Celsius.

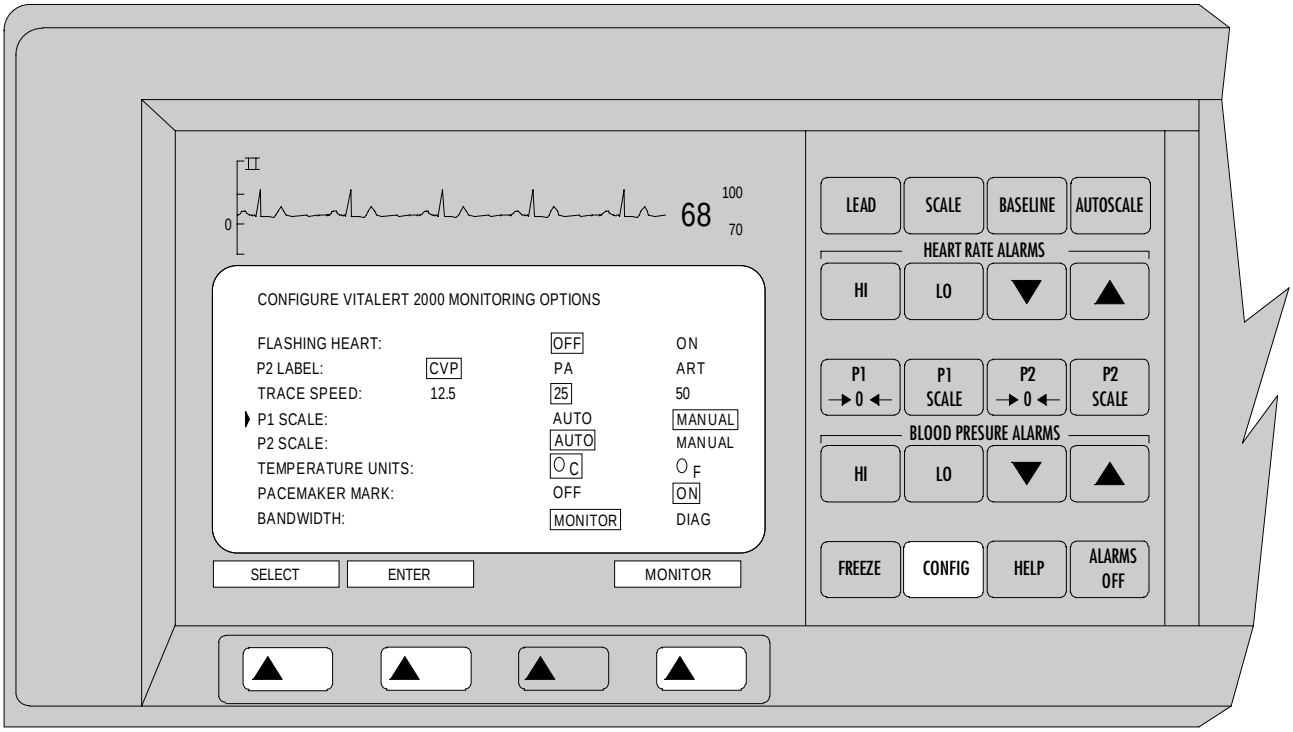

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FIGURE 5: MONITORING OPTIONS CONFIGURATION SCREEN

Pacemaker Mark

The Pacemaker Mark function enables the display of a marker in the ECG waveform to represent an artificial pacemaker pulse (if present). On power-up, the Pacemaker Mark display is disabled.

ECG Bandwidth

The bandwidth setting selects an ECG monitoring bandwidth of 0.5 Hz to 40 Hz, or a diagnostic bandwidth of 0.05 Hz to 100 Hz. On power-up, the bandwidth defaults to monitoring.

VITALERT 2000 Audio Adjustments

The Audio Adjustments screen (Fig. 6) allows the operator to set the volume of the alarm and heart tone audio features. The ECG/SaO2 Audio Interlock is also enabled on this screen.

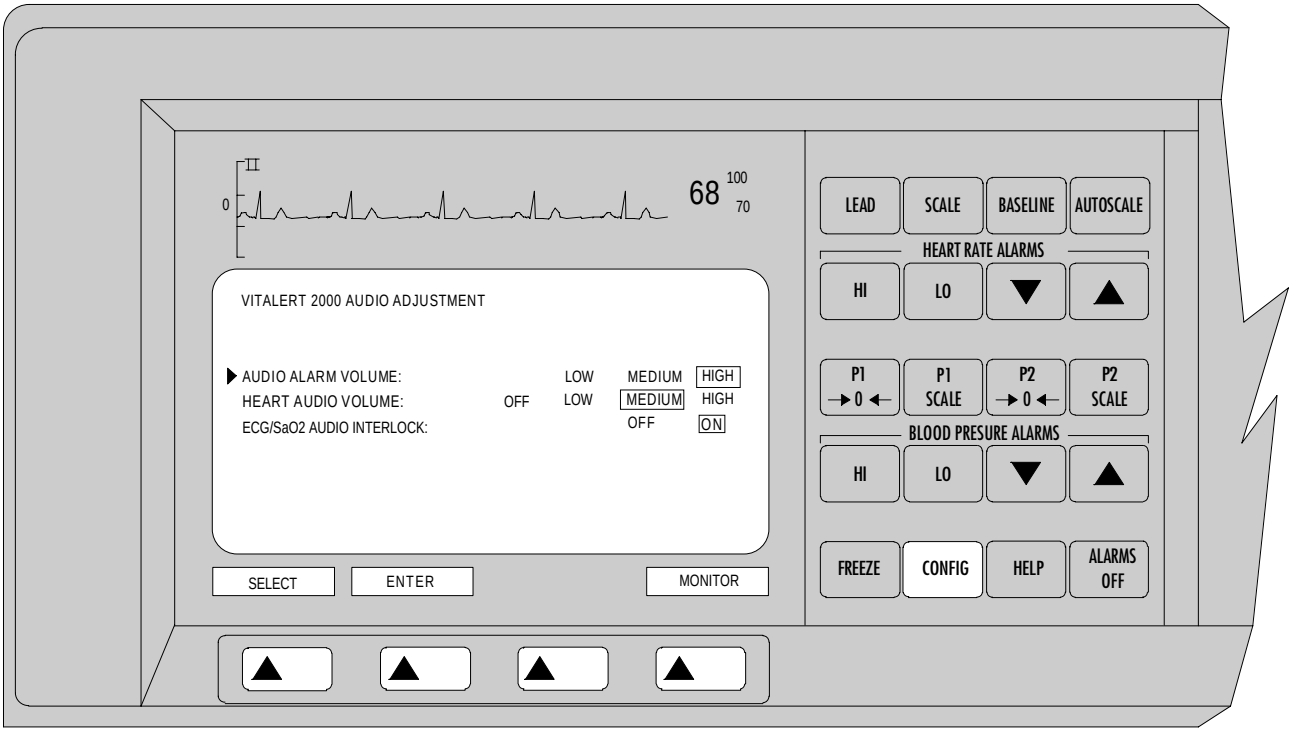
Audio Alarm Volume

The first function, Audio Alarm Volume, selects one of three alarm annunciation levels (Low, Medium, High).

NOTE: When interfaced to a host monitoring system such as the NARKOMED 3, NARKOMED 2B, or VITALERT 1000, audible alarms annunciate through the host monitoring system.

Heart Audio Volume

The Heart Audio Volume function allows the operator to enable or disable an audio tone



OP27006

FIGURE 6: AUDIO ADJUSTMENTS CONFIGURATION SCREEN

for each heartbeat, by selecting Off, Low, Medium, or High.

ECG/SaO2 Audio Interlock

The ECG/SaO2 Audio Interlock function allows the operator to silence the Heart Audio Volume function when the VITALERT 2000 receives a valid pulse rate from an interfaced pulse oximeter.

Alarm Limits Adjustment

The Set Alarm Limits screen (Fig. 7) allows the operator to set both current and default alarm limits. Using the displayed measurement values as reference, the operator can set the high and low alarm limits for the heart rate, P1 Arterial Systolic, P2 CVP Mean, P2 PA Diastolic and P2 Arterial Systolic blood pressure. The power-on default alarm limit values are also set on this screen. The power-on default selections are retained in memory even when the VITALERT 2000 is turned off. The adjustment range for each alarm limit is given in the chart below.

ALARM LIMIT	ADJUSTMENT RANGE
Low Heart Rate	30 bpm to (high heart rate - 1)
High Heart Rate	(low heart rate + 1) to 250 bpm
Low Arterial Systolic	30 mm Hg to (high systolic - 1)
High Arterial Systolic	(low systolic + 1) to 285 mm Hg
Low CVP Mean	0 mm Hg to (high mean - 1)
High CVP Mean	(low mean + 1) to 60 mm Hg
Low PA Diastolic	0 mm Hg to (high diastolic - 1)
High PA Diastolic	(low diastolic +1) to 60 mm Hg

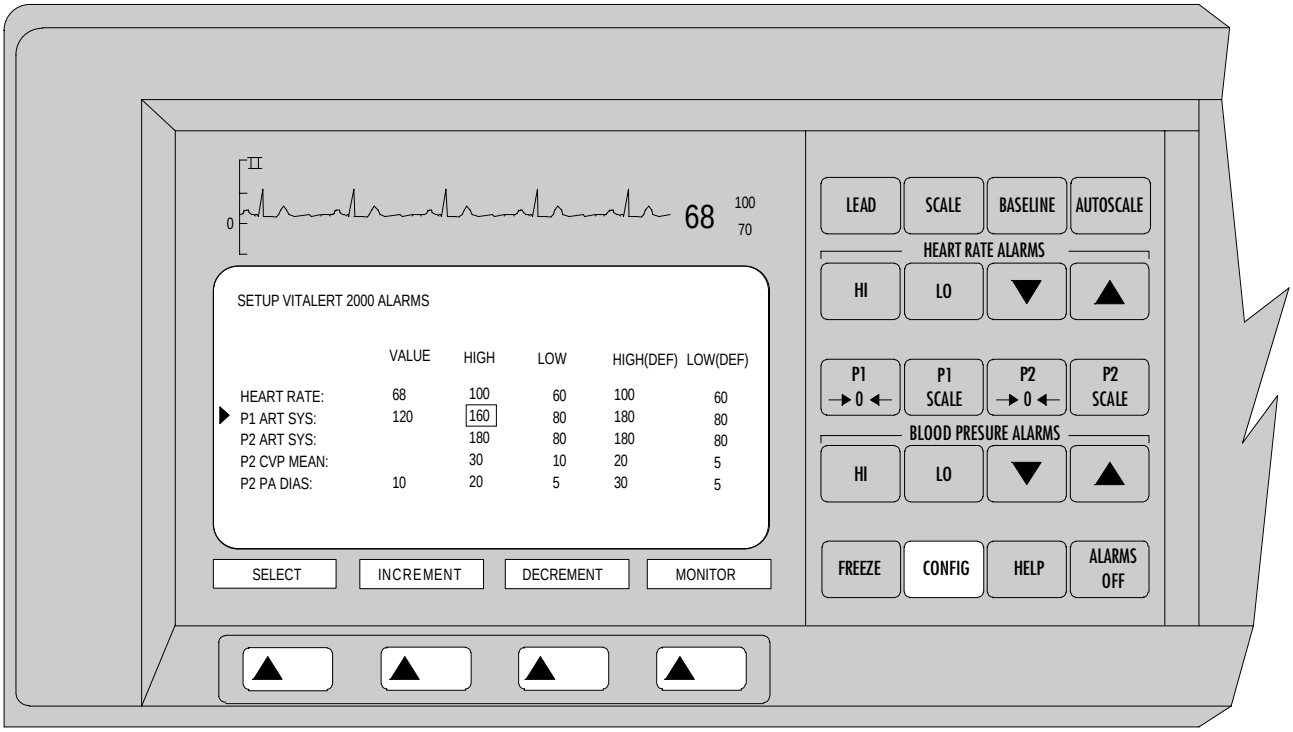


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FIGURE 7: ALARM LIMITS CONFIGURATION SCREEN

Auto Print and Auto Plot Configuration

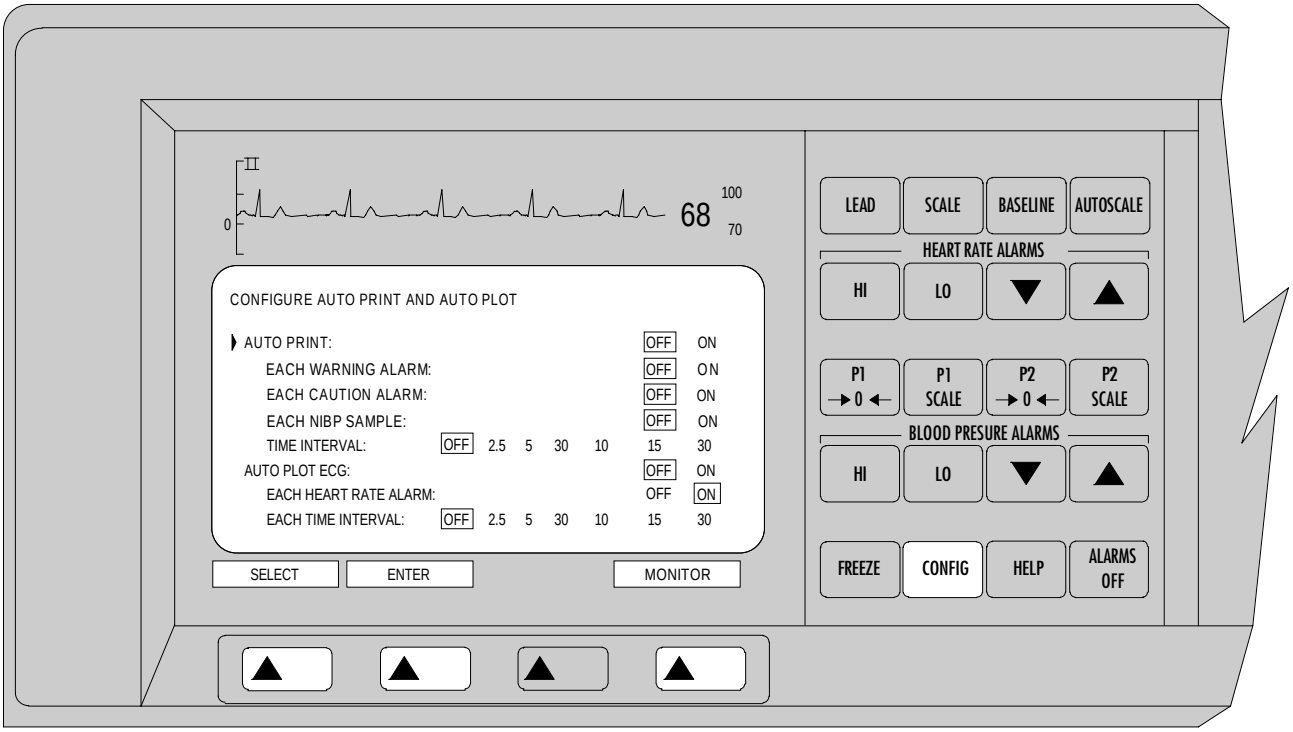
This Configuration screen (Fig. 8) enables the Auto Print and Auto Plot ECG functions, using the strip chart recorder. Auto Print allows the VITALERT 2000 to automatically produce a printout of the Monitor system data values when the selected criteria are met. Auto Plot ECG allows the VITALERT 2000 to automatically produce a plot of the ECG waveform when the selected criteria are met.

Auto Print

By selecting the ON option of the Auto Print function, the operator can choose to have the VITALERT 2000 produce a printout of current data values on the strip chart recorder when one or more of the following occur:

- Warning alarm
- Caution alarm
- Noninvasive blood pressure measurement
- Preselected time interval (every 2.5, 5, 10, 15, or 30 minutes)

On power-up, the VITALERT 2000 defaults the Auto Print function to OFF; all criteria selections are retained in memory.



OP27008

FIGURE 8: AUTO PRINT AND AUTO PLOT CONFIGURATION SCREEN

CONFIGURATION (continued)

Auto Plot ECG

By selecting the ON option of the Auto Plot ECG function, the operator can choose to have the VITALERT 2000 plot the ECG waveform on the strip chart recorder when one or more of the following occur:

- Heart rate alarm
- Preselected time interval (every 2.5, 5, 10, 15, or 30 minutes)

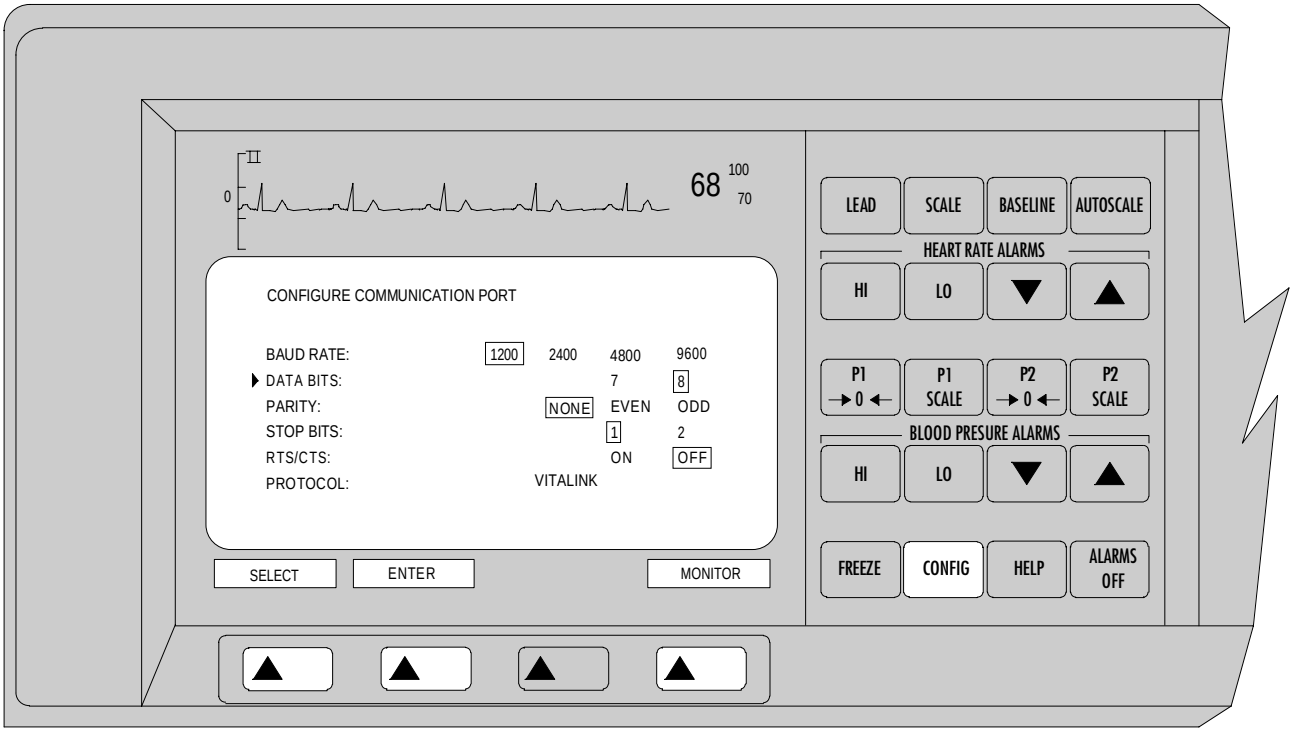
On power-up, the VITALERT 2000 defaults the Auto Plot function to OFF; all criteria selections are retained in memory.

Communication Port Configuration

This configuration screen (Fig. 9) allows the operator to configure the serial port for communication with the NARKOMED 3, NARKOMED 2B, VITALERT 1000, or other device capable of communications via Vitalink.

The following serial port configurations are possible:

BAUD RATE:	1200, 2400, 4800 or 9600
DATA BITS:	7 or 8
PARITY:	ODD, EVEN or NONE
STOP BITS:	1 or 2
RTS/CTS:	ON or OFF



OP27009

FIGURE 9: COMMUNICATION PORT CONFIGURATION SCREEN

CONFIGURATION (continued)

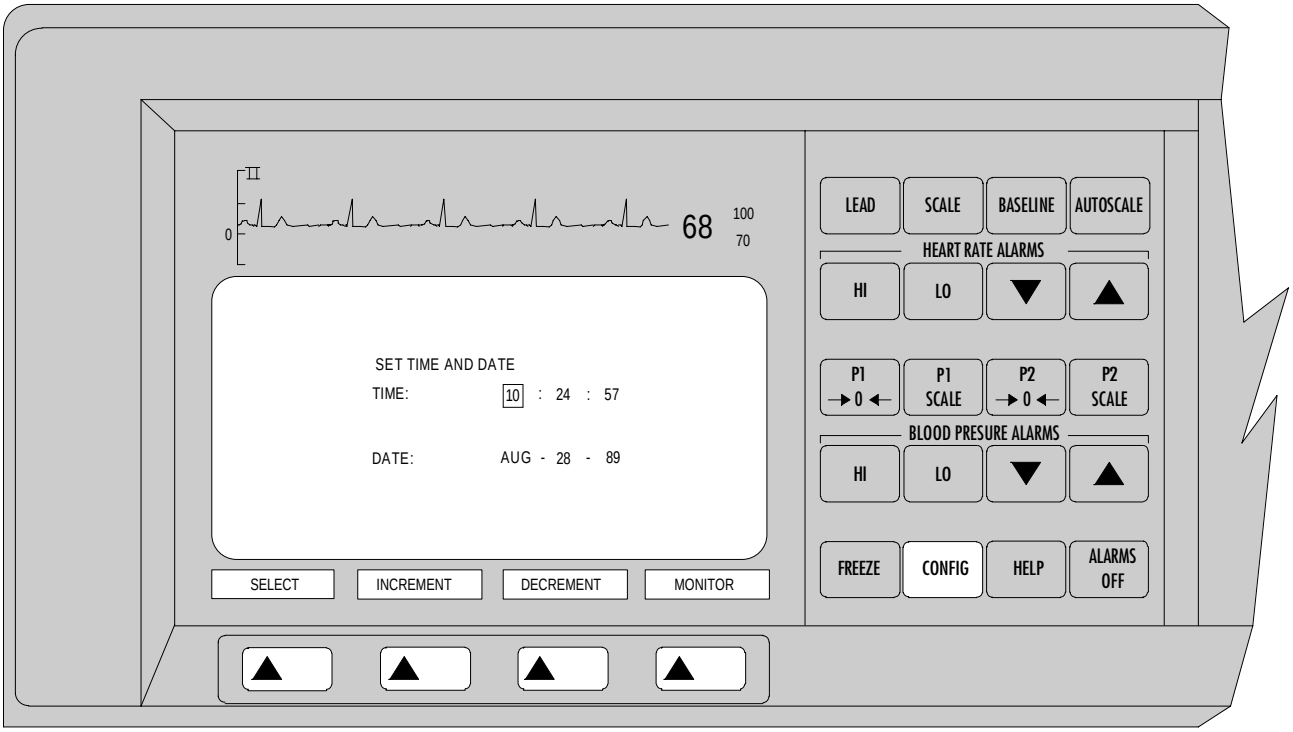
The serial port configuration is retained in memory when the VITALERT 2000 is turned off.

Set Time and Date Configuration

This Configuration screen (Fig. 10) allows the operator to set the current date and time (24 hour clock). The VITALERT 2000 maintains the current date and time even when the unit is in the STANDBY mode and unplugged (if the battery is not depleted).

When interfaced with a NARKOMED 3, NARKOMED 2B, or VITALERT 1000, the date and time are automatically set by the host system.

When used as a stand alone monitor, turn the VITALERT 2000 to STANDBY then to ON again after time and date changes. This ensures the correct time on trend plots.



OP27010

FIGURE 10: TIME AND DATE CONFIGURATION SCREEN

OPERATING INSTRUCTIONS

Turning on the VITALERT 2000

The ON and STANDBY keys control the power to the VITALERT 2000 (Fig. 11). Pressing the ON key activates the VITALERT 2000, which responds by performing a series of self-diagnostic checks to verify its ability to function properly. The results of these tests are posted on the screen. At the conclusion of the self-diagnostic tests, a summary of any problems and the operational status are posted on the display screen.

The operational status of the VITALERT 2000 may be any one of the following:

FUNCTIONAL - The VITALERT 2000 initiates normal monitoring operation.

CONDITIONALLY FUNCTIONAL - Any minor deficiencies are posted, and the operator must press the CONTINUE soft key. A North American Dräger service representative should be notified.

NON-FUNCTIONAL - The self-diagnostics reveal a problem in the VITALERT 2000. A summary of the diagnostic results is posted and normal operation is inhibited. A North American Dräger service representative should be notified immediately.

Each time the VITALERT 2000 is turned on, it resets all alarm limits to their power-on default values and disables the pacemaker mark function, the Auto Print function and the Auto Plot function. The VITALERT 2000 also selects the monitoring bandwidth, sets the waveform speed to 25 mm/sec, and the ECG scale to 10 mm/mV on power-up. All other configuration settings are retained from the last VITALERT 2000 configuration. Refer to the previous chapter to make changes to the VITALERT 2000 configuration.

Keyboard Operation

A description of each key's function is given below.

ON - activates the VITALERT 2000 Monitor. The VITALERT 2000 can also be remotely activated through its external communications port. When interfaced to a NARKOMED 3 anesthesia system, the VITALERT 2000 is automatically activated by the System Power switch.

STANDBY - disables the VITALERT 2000. The battery charger of the VITALERT 2000 continues to operate as long as the VITALERT 2000 is plugged into an active AC outlet.

ALARMS ON/OFF - disables all VITALERT 2000 patient alarms (Heart Rate and Blood Pressure). While alarms are disabled, an advisory message is placed on the VITALERT 2000 display screen. Alarms can be re-enabled by pressing the ALARMS DISABLE key again.

HELP - invokes the Help mode to assist the operator in understanding the operation of the VITALERT 2000.

CONFIG - invokes the Configuration mode to allow the operator to customize the operation of the VITALERT 2000.

FREEZE - stops and saves a portion of the current ECG waveform on the VITALERT 2000 Monitor screen. Real time data continues to be accumulated and displayed above the frozen ECG waveform.

SOFT KEYS - used to manipulate the Configuration, Help and Freeze screens.

LEAD - used to select the desired limb lead to be displayed (See *ECG Lead* section for more details).

OPERATING INSTRUCTIONS (continued)

SCALE - sets the desired waveform scale.

BASELINE - used to adjust the waveform baseline.

AUTOSCALE - automatically sets the waveform scale and baseline for the selected lead.

HEART RATE ALARM LIMIT KEYS - set the alarm limits for the heart rate, displayed to the right of the ECG waveform on the Monitor screen. The HI key selects the upper heart rate limit; the LO key selects the lower heart rate limit. Pressing either the HI or LO key places a box around the corresponding limit on the Monitor screen. The increment and decrement keys (labeled with arrows) increase or decrease the selected limit.

PRESSURE ZERO (P1 ->0<-, P2 ->0<-) - used for each of the invasive blood pressure channels to zero the pressure transducer once it is properly positioned for zero reference calibration. Each channel must be zeroed following power-up and transducer setup for invasive blood pressure monitoring to begin. To zero the pressure transducer, the input pressure must be stable with an offset of less than 150 mm Hg.

PRESSURE SCALING (P1 SCALE & P2 SCALE) - selects the display scale for the respective invasive blood pressure channels. Each channel has its own scale to optimize the resolution of the display waveforms. If configured, the VITALERT 2000 will automatically select the display scale, based

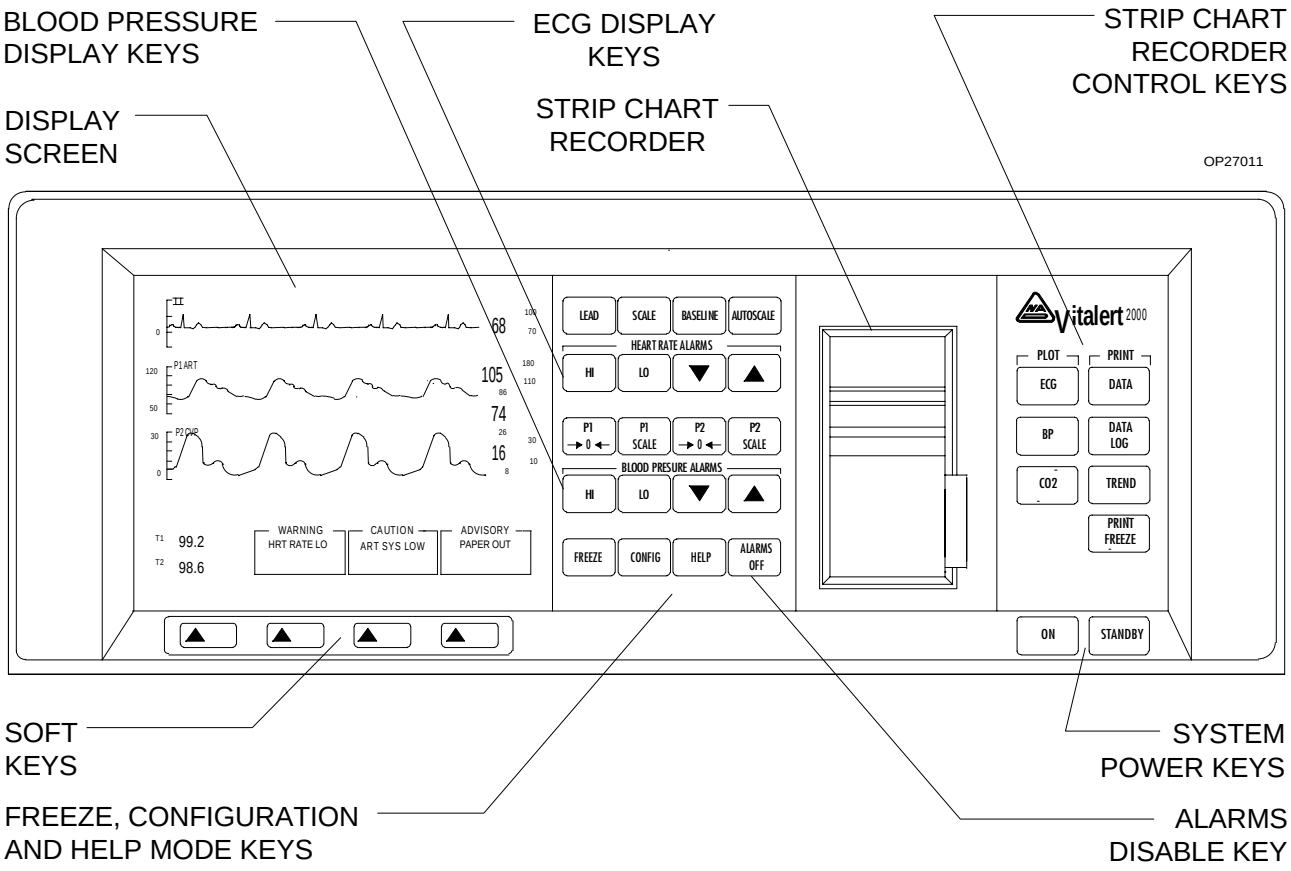


FIGURE 11: VITALERT 2000 FRONT PANEL

on the systolic and diastolic values, when the Scale key is pressed. Otherwise, the operator may manually choose one of several fixed scales by pressing the Scale key. (See *Configuration* section for more details.)

BLOOD PRESSURE ALARM LIMIT KEYS - set the alarm limits for the P1 systolic and P2 systolic, mean or diastolic blood pressures. The HI key selects the upper blood pressure limit; the LO key selects the lower blood pressure limit. Pressing either the HI or LO key places a box around the corresponding limit on the Monitor screen. Pressing either the HI or LO key consecutively toggles the display between the P1 and P2 HI or the P1 and P2 LO. The increment and the decrement keys (labeled with arrows) increase or decrease the selected limit.

Strip Chart Recorder Operation

The following keys control the operation of the strip chart recorder:

ECG PLOT - initiates a printed copy of the ECG waveform on the strip chart recorder; pressing the ECG PLOT key again will abort the plot.

BP PLOT - initiates a printed copy of the P1 arterial blood pressure waveform on the strip chart recorder; pressing the BP PLOT key again will abort the plot.

NOTE: Simultaneously pressing the ECG PLOT & BP PLOT keys produces concurrent plots of the ECG waveform and the P1 waveform.

CO2 - initiates a printed copy of the CO_2 waveform on the strip chart recorder; the plot will be suspended after 12 seconds of data have been printed, the CO2 key is pressed again, or Vitalink communications are interrupted. If CO_2 waveform data is not available, the message "NO WAVEFORM DATA" is printed on the strip chart recorder.

TREND PLOT - initiates a printed copy of each trended measurement of the anesthesia system; pressing the TREND PLOT key again will abort the TREND plot after completion of the current trend.

DATA PRINT - prints a brief report of the current anesthesia system data values.

DATA LOG PRINT - prints out the last 40 events from the anesthesia system data log on the strip chart recorder. Pressing the DATA LOG key again while printing will abort the data log after completion of the current page.

PRINT FREEZE - prints out the last FREEZE ECG waveform in a format similar to the ECG TRACE PLOT. Pressing FREEZE or PRINT FREEZE while the printing is in progress will abort the plot. If no waveform data exists or the data is invalid, the message "NO FREEZE WAVEFORM" is printed on the strip chart recorder.

Monitoring Display

The VITALERT 2000 uses a 7-inch CRT for the presentation of waveforms, measurements, and alarms. Four different types of display screens appear on the Monitoring Display: the Monitor screen, the Freeze screen, the Configuration screens, and the Help screens.

A description of each display screen's function follows.

Monitor Screen

The Monitor screen (Fig. 12) provides the operator with VITALERT 2000 measurements, waveforms and alarms. The Monitor screen is invoked automatically on power-up, following diagnostics.

The information on the Monitor screen is organized into six areas: the ECG display, the P1 invasive blood pressure display, the P2 invasive blood pressure display, the T1 temperature display, the T2 temperature display, and the alarms display.

If only one pressure channel is being used, the VITALERT 2000 expands the ECG section on the Monitor screen to include two passes of the ECG waveform. If neither pressure channel is used, the VITALERT 2000 cascades the ECG waveform to include three passes on the Monitor screen.

The VITALERT 2000 knows if a measurement is not being received by the absence of its sensor signal. If a sensor signal is received at initialization, then ceases, the VITALERT 2000 registers a disconnect, which is indicated as an Advisory message at the bottom of the screen. However, if the ECG cable is not connected at power-up, the VITALERT 2000 will also register a disconnect.

ECG Display

The ECG display of the VITALERT 2000, located at the top of the monitor screen, includes: the ECG waveform, the heart rate, heart rate alarm limits, the flashing heart, and the selected ECG lead. A description of each section is given below.

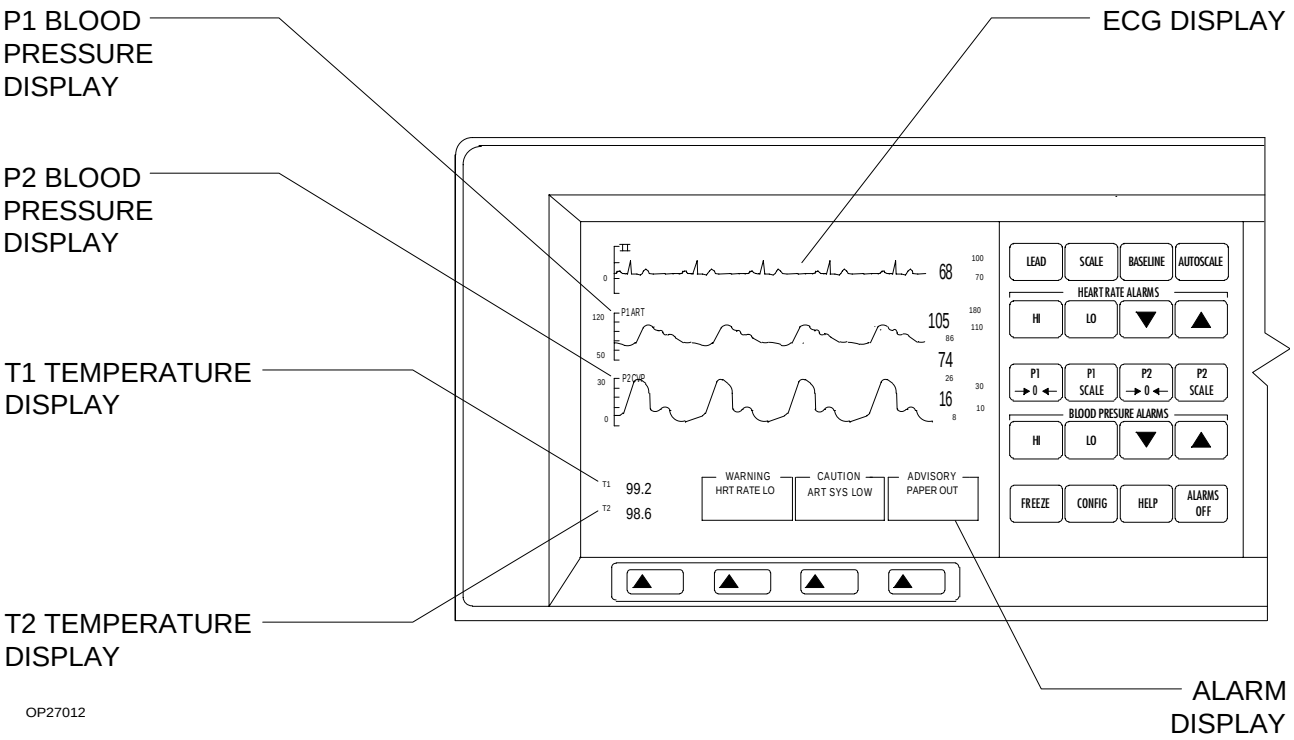


FIGURE 12: VITALERT 2000 MONITOR SCREEN

ECG Waveform

The VITALERT 2000 displays the ECG signal at the trailing edge of a blank bar which moves from left to right across the screen. The previous sweep's data is erased at the leading edge of the "blank bar." This method of waveform refresh allows the operator to view a stationary waveform. In the event that multiple passes of the ECG waveform are made, the waveform remains stationary as the "blank bar" moves from trace to trace. The sweep rate is configurable to 12.5, 25 or 50 mm/sec. The sweep rate can be manually selected using the Trace Speed function in the Monitoring Options Configuration screen. If artificial pacemaker pulses are present in the ECG signal, their effect on the waveform is suppressed by the VITALERT 2000. If desired, a mark can be displaced on the ECG waveform to represent a pacemaker pulse. This feature can be activated using the Pacemaker Mark function in the Monitoring Options Configuration screen.

The amplitude, shape, and polarity of the waveform are affected by the patients age, size, and physical condition. Skin preparation, electrode placement, lead selection, and noise will also affect waveform detection.

Heart Rate

The VITALERT 2000 derives the heart rate from the ECG waveform. Following R wave detection, a signal is generated to other portions of the VITALERT 2000 to produce the heart audio and flashing heart symbol. The interval between R waves is measured, recorded and then used to compute the displayed heart rate. The value of the heart rate is displayed, in large characters, to the right of the ECG waveform. The displayed heart rate is based on the rate of the most recent beats with asystole factored in after two seconds. Averaging is performed with more weight applied to the interval rate of the most recent beats. This method provides quick response to tachycardias, bradycardias and the tracking of rate changes.

The R-wave detection module requires a few seconds to characterize the incoming signal.

Heart Rate Alarm Limits

The heart rate alarm limits are displayed, in small characters, directly to the right of the heart rate. The high and low alarm limits can either be adjusted in the Configuration mode, or directly on the Monitor screen using the HI, LO, INC, and DEC keys in the HEART RATE ALARM section of the main keyboard. While being adjusted on the Monitor screen, the selected limit is enclosed in a box.

Flashing Heart

To denote the detection of an R wave, the VITALERT 2000 can be configured to flash a heart-shaped symbol in the upper right corner of the Monitor screen and annunciate a brief audio tone. The VITALERT 2000 registers beats on the R waves of the ECG waveform. The flashing heart can be independently selected, using the Configuration mode. The heart audio tone, selected in the Configuration mode, may also be disabled when the VITALERT 2000 operates in conjunction with a pulse oximeter (see *Configuration* section).

ECG Lead

The VITALERT 2000 displays the selected ECG lead in the upper left hand corner of the screen (Fig. 13). The operator can adjust ECG functions through the following keys.

LEAD - Allows the operator to manually select one of seven lead choices (I, II, III, aVR, aVL, aVF, or V). A specific lead is selected by repeatedly pressing the LEAD key until the choice is displayed in the upper left corner of the CRT.

SCALE - Once a lead has been selected, this soft key allows the operator to manually select one of five scales (1.5, 2.5, 5, 10 and 15 mm/mV). Each scale segment represents 1 mV.

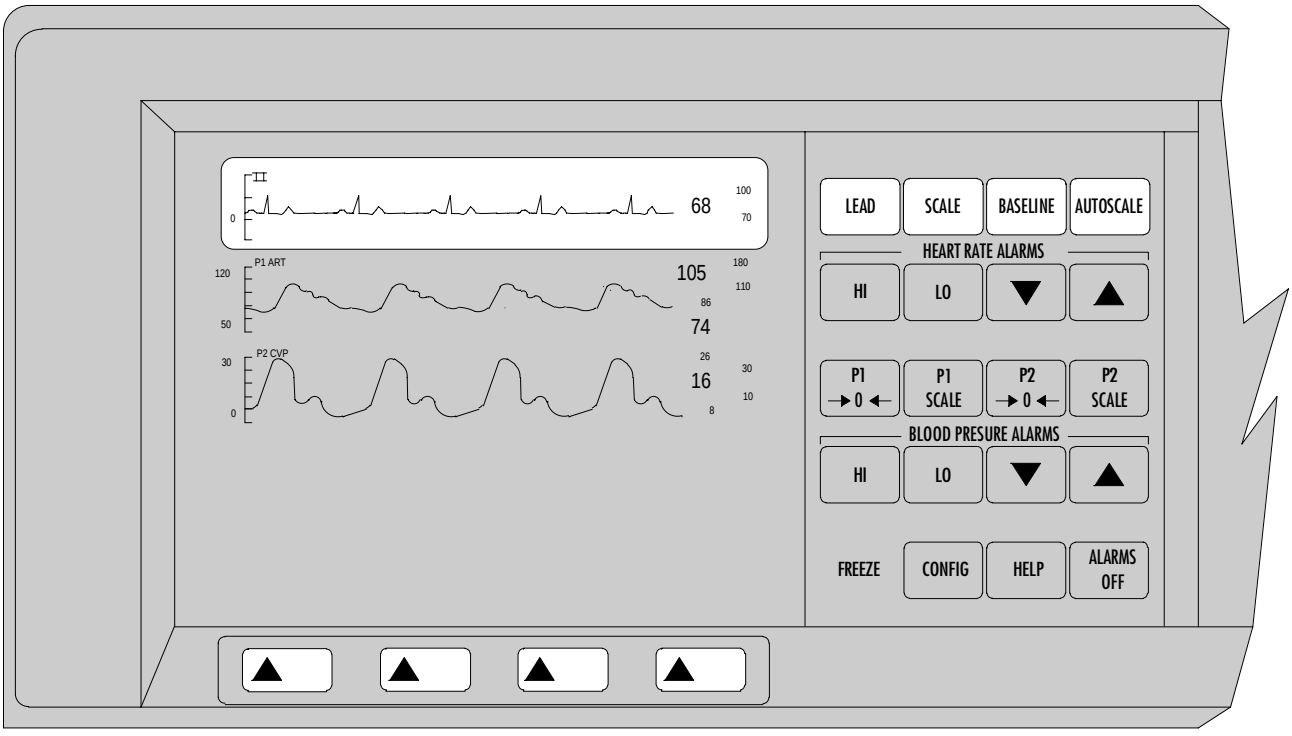
BASELINE - Allows the operator to adjust the waveform's baseline along the graph scale.

AUTOSCALE - Allows the VITALERT 2000 to select the waveform scale and baseline for the selected lead, based on the size and polarity of the ECG waveform. When pressed, the label SCALING appears next to the lead label to indicate that the Autoscaling feature is activated.

ECG Channel Noise

During the use of an Electrosurgical Unit or in cases of a lead fault condition, the message NOISY SIGNAL - CHECK LEADS may appear in place of the ECG waveform. The flashing heart indicator is removed from the display, and any ECG-related alarms that would normally be displayed at the bottom of the screen are also suppressed, along with the heart audio tone. The Blood Pressure and Temperature displays remain unaffected.

Lead faults may be caused by various conditions, including lead disconnects, damaged or wet wires or cable, wires consistently exposed to liquid disinfectants, dried out electrodes, or poor electrode site selection or preparation.



OP27013

FIGURE 13: ECG OPTIONS

Blood Pressure Display

The Blood Pressure display on the VITALERT 2000 is separated into two channels (P1 and P2). Each channel has four sections: the blood pressure waveform, the blood pressure waveform scale, blood pressure measurements, and blood pressure alarm limits. A description of each section is given below.

Blood Pressure Waveforms

The VITALERT 2000 updates and displays both P1 and P2 invasive pressure waveforms in the same manner as the ECG waveform, using the moving "blank bar."

Blood Pressure Channel Labels

The VITALERT 2000 labels the P1 pressure channel P1 ART to indicate arterial pressure. The P2 pressure channel can be labeled for central venous pressure (P2 CVP), pulmonary artery pressure (P2 PA), or as a second arterial pressure (P2 ART). The P2 pressure channel label may be selected via the Configuration mode.

Blood Pressure Waveform Scales

The VITALERT 2000 displays a graphic pressure scale to the left of the waveform for each blood pressure trace. Either manual or automatic pressure scaling can be selected via the P1 Scale and P2 Scale functions in the Configuration Mode. Manual scaling allows the operator to select from the following fixed scales (mm Hg):

- Arterial: 60–90, 60–135, 50–200, 0–300
- CVP and PA: 0–15, 0–30, 0–75, 0–150, 0–300

Automatic arterial scaling selects a scale 5–20 mm Hg larger than the pulse pressure centered about the waveform.

CVP or PA pressures are shown on a scale where the lower boundary is zero and the upper boundary is 5–10 mm Hg above the systolic pressure.

Blood Pressure Measurements

The VITALERT 2000 displays the systolic, mean, and diastolic values to the right of each pressure waveform.

Blood Pressure Alarm Limits

High and low alarm limits are provided for the P1 systolic pressure and P2 ART (systolic), P2 CVP (mean), or P2 PA (diastolic) pressure (depending on configuration selection). These alarm limits are displayed immediately to the right of their respective measurements. Both high and low limits for each of the two pressure channels can either be adjusted in the Configuration mode or directly on the Monitor screen using the HI, LO, INC, and DEC keys in the BLOOD PRESSURE ALARM section of the main keyboard. While being adjusted on the Monitor screen, the selected limit is enclosed in a box.

Temperature Display

The Temperature display on the VITALERT 2000 is separated into two channels (T1 and T2). Patient temperature measurements are displayed in the lower left section of the screen. The units of measure for temperature are degrees Celsius or degrees Fahrenheit. The units of measure can be selected in the Configuration mode.

Alarm Display

The Alarm display occupies the bottom of the Monitor screen. As alarm conditions occur, alarm messages (such as HRT RATE LOW) are indicated in one of three categories of the Alarm display: Warning, Caution, and Advisory. Each type of alarm message produces a different sound pattern:

Warning: A continuously repeating tone pattern.

Caution: An intermittently repeating tone pattern.

Advisory: A single tone or no tone.

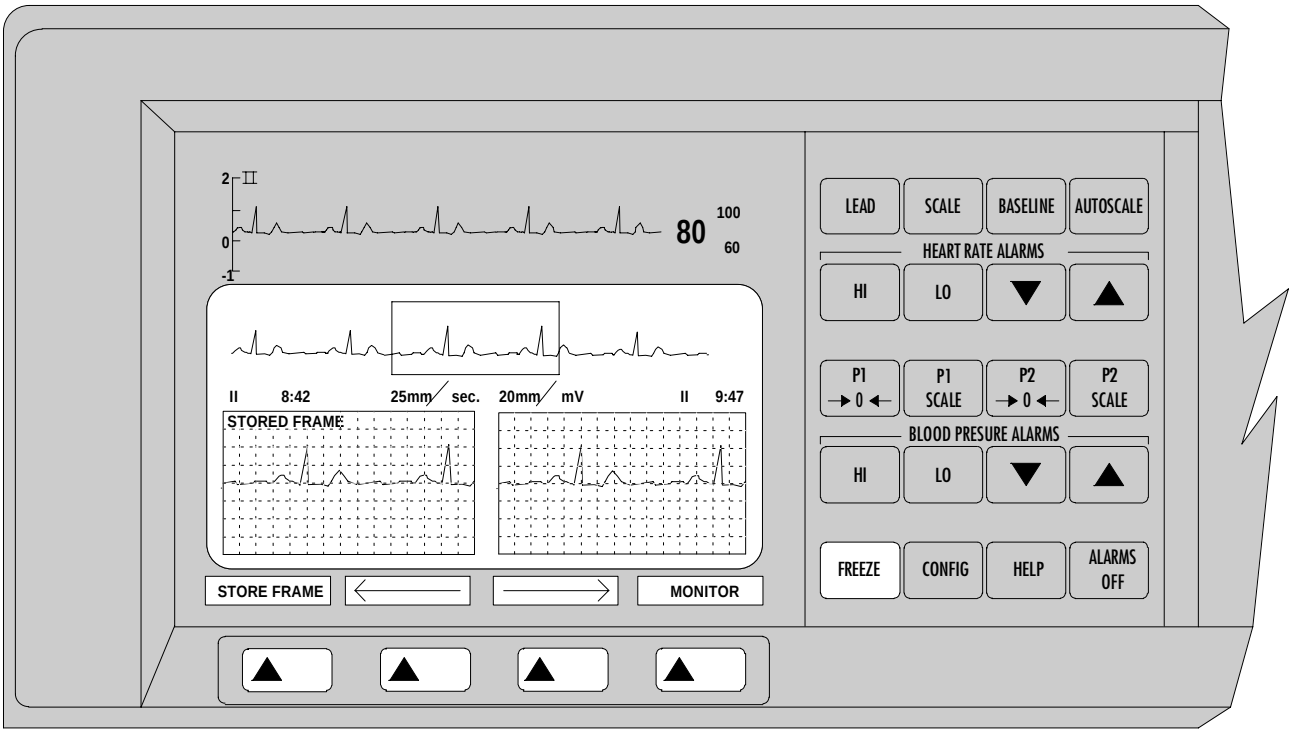
Alarm messages are listed in order of the time of occurrence, with the most recent alarm messages appearing at the bottom of the list. If interfaced to a host system, VITALERT 2000 audio alarms are disabled; the alarm condition is communicated and signaled through the host system.

NOTE: If the number of alarm messages in any of the three categories exceeds the space provided on the display screen for that category, additional alarm messages will be held in the machines memory until space is available (i.e., through the resolution of some of the displayed alarm conditions). See Appendix 2 for a list of the Alarm messages currently supported by the VITALERT 2000.

ECG Freeze Screen

The VITALERT 2000 invokes the ECG Freeze screen when the FREEZE key is pressed (Fig. 14). The ECG Freeze screen allows the operator to closely analyze a fixed portion of the ECG waveform.

The ECG Freeze screen contains a 16 second section of the ECG waveform. A portion of the waveform, enclosed by a box, is expanded for closer examination. This portion is displayed on a 5 mm grid. The two center soft keys can be used to move the box to the left or right to view any portion of the frozen waveform in detail. The operator can store a frame of waveform by isolating the area of interest, then pressing the STORE FRAME soft key. The frame is then displayed in the left box with the time and lead above the box. This frame is displayed in the left box until a new frame is stored.



OP27014

FIGURE 14: ECG FREEZE SCREEN

The VITALERT 2000 returns to the Monitor screen one minute after the last keystroke in the ECG Freeze Screen.

NOTE: Pressing the FREEZE key while viewing the ECG Freeze screen creates a new trigger point on the ECG waveform and displays a new fixed waveform on the ECG Freeze screen.

Help Screens

The Help menu (Fig. 15), invoked by pressing the HELP key, is intended to assist the operator in understanding the VITALERT 2000. The Help menu allows the operator to select one of four Help topics:

- Pre-Use Checkout Procedures
- Vitalert 2000 Operation
- Strip Chart Recorder Paper Loading Instructions
- Warnings and Precautions

The operator chooses a specific Help topic by pressing the soft key labeled SELECT to advance the cursor to the corresponding topic label on the menu, then pressing the ENTER soft key. After a topic is selected, the operator can view the various screens within the topic by using the labeled soft keys beneath the display.

The VITALERT 2000 automatically returns to the Monitor screen one minute following the last keystroke in the Help mode.

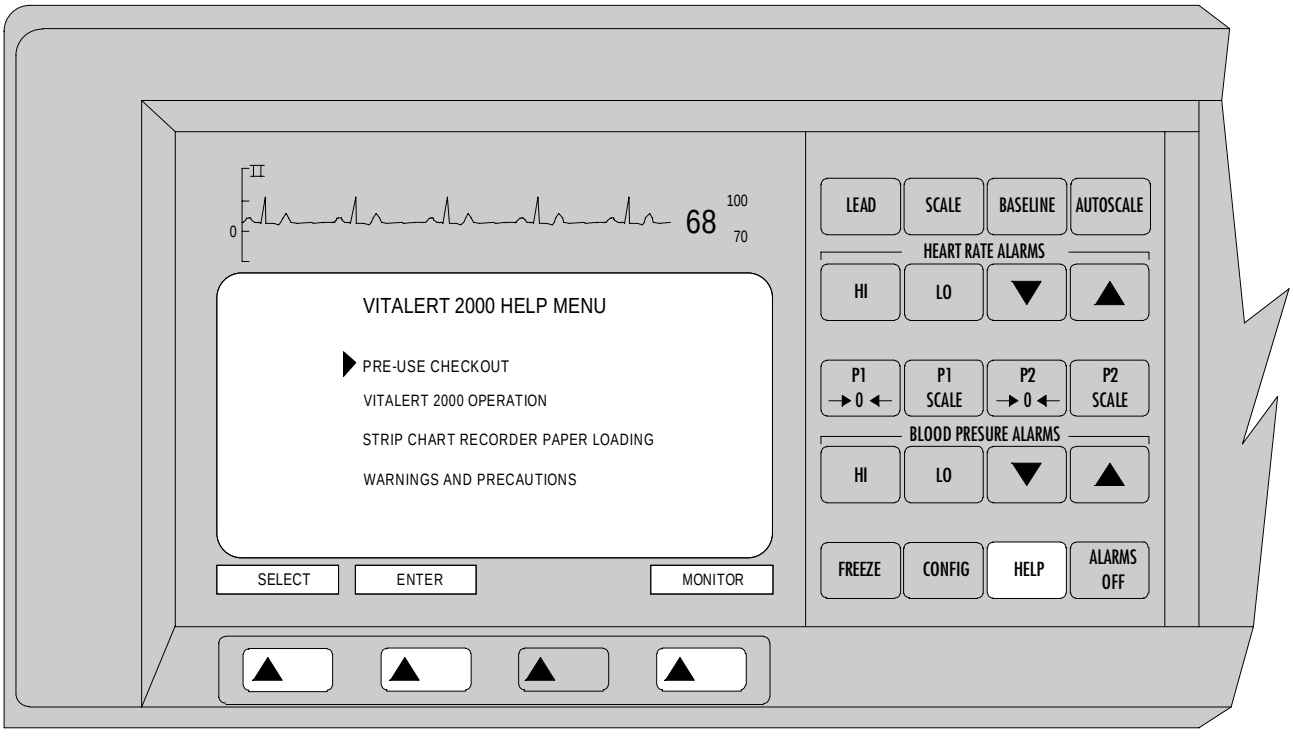


FIGURE 15: HELP MENU

Pre-Use Checkout Procedure

The Pre-Use Checkout procedure, invoked through the HELP menu, is designed to guide the operator through a recommended monitor setup procedure.

VITALERT 2000 Operation

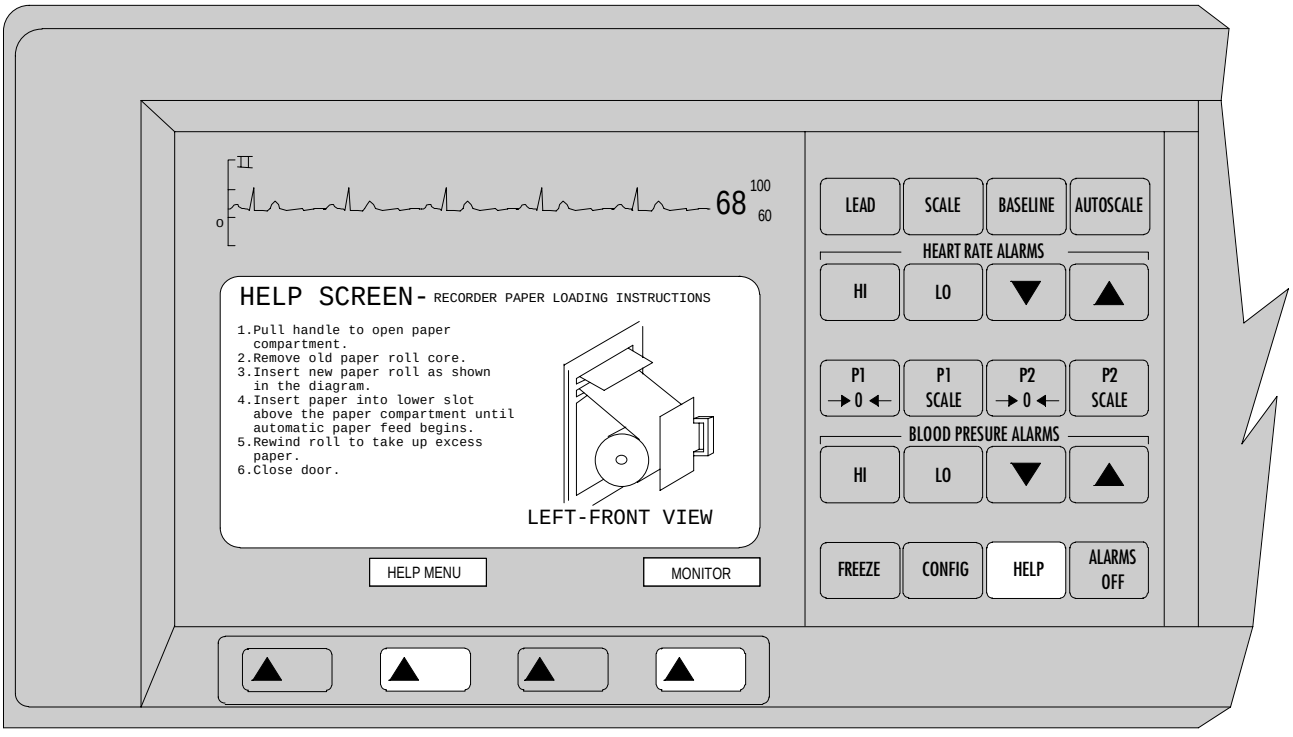
The VITALERT 2000 Operation Help topic offers a key-by-key description, allowing the operator to enter a mode in which any keystroke invokes a description of the keys function.

Strip Chart Recorder Paper Loading Instructions

The Strip Chart Recorder Paper Loading Instructions (Fig. 16) describe how to load the roll paper into the strip chart recorder.

Warnings and Precautions

The Warnings and Precautions topic provides a list of warnings and cautions that must be followed for the safe and effective operation of the VITALERT 2000 monitor.



OP27016

FIGURE 16: STRIP CHART RECORDER PAPER LOADING HELP SCREEN

CLEANING AND STERILIZATION

Exterior Surfaces

Exposed surfaces of the VITALERT 2000 may be cleaned with a mild detergent solution. The temperature plugs may be cleaned with isopropyl alcohol.

Abrasive materials and solvents should not be used. Do not allow liquid to enter the interior of the VITALERT 2000.

PRECAUTIONS FOR MAINTENANCE AND USE

Warnings

Any person involved with the setup, installation, operation or maintenance of the VITALERT 2000 Monitoring System must be thoroughly familiar with this instruction manual.

The VITALERT 2000 Monitoring System is designed to be operated under the constant surveillance of a qualified operator.

The Pre-Use Checkout procedure must be performed immediately prior to each application of the VITALERT 2000.

The VITALERT 2000 shall not be used in the presence of flammable anesthetics.

Repair service of the VITALERT 2000 shall only be performed by an authorized representative of North American Dräger.

WARNING - PACEMAKER PATIENTS: The VITALERT 2000 may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. Do not rely entirely upon VITALERT 2000 alarms. Keep pacemaker patients under close surveillance. See disclosure of the pacemaker pulse rejection capability of this instrument.

Cautions

When moving equipment which has a VITALERT 2000 mounted to it, remove the VITALERT 2000, and move it separately.

When plugged into the AC convenience receptacle of another device, the VITALERT 2000 contributes approximately 30 A to the total system chassis leakage of that device. This total leakage shall not exceed 100 A.

When not in use, the VITALERT 2000 should be plugged into an active AC receptacle to maintain the backup battery in a fully-charged position.

Because of the risk of electric shock, do not remove the cover. Refer any servicing to qualified service personnel.

Although designed to minimize the effects of ambient radio-frequency interference, the functioning of the VITALERT 2000 may be adversely affected by the operation of electrosurgical equipment, short wave or microwave diathermy equipment in the vicinity. To prevent ESU overload, use the leads and cables specified in the Spare and Replacement Parts section of this manual.

Needle-type ECG electrodes should not be used with ESU.

The VITALERT 2000 is designed to rapidly recover from system overload. However, some electrode types are subject to large offset potentials. As a result, system recovery time may be affected, especially after defibrillation.

SPARE AND REPLACEMENT PARTS

Description	Part Number
VITALERT 2000 Operator's Manual	4110145
Data Cable (DB9/DB25/30 in)	4109882
Data Cable (DB9/DB9/30 in)	4110328
Power Cable (180 in)	4109600
Power Cable (72 in)	4110334
Power Cable (36 in)	4110333
ECG Cable	4112845
ECG Lead Set (5 leads)	4112846
Sorenson Research Transpac II Blood Pressure Cable	4110917
Sorenson Research Transpac III/IV Invasive Blood Pressure Cable	4112024
Spectromed DTX Blood Pressure Cable	4110916
Utah Medical Deltran II Blood Pressure Cable	4110918
Cobe CDX III Blood Pressure Cable	4110554
Temperature Probes - YSI Series 700 (2)	4107800
Chart Paper (1 roll)	4110335
Vitalink Technical Reference Manual	4110117
VITALERT 2000 Service Manual	4110966

APPENDIX 1: VITALERT 2000 SPECIFICATIONS

General

Overall dimensions (L x W x H) . . . . . 19.5 x 17.5 x 7 inches

Weight . . . . . 37 pounds

Display screen size . . . . . 7 inch diagonal

Display screen phosphor . . . . . C194 (Amber)

Electrical

Input voltage . . . . . 90 to 130 VAC @ 50/60 Hz
180 to 265 VAC @ 50/60 Hz (VITALERT 2000E)

Input current . . . . . $\leq$ 1 Amp @ 117 VAC, 60 Hz
$\leq$ 0.5 Amp @ 230 VAC, 50 Hz (VITALERT 2000E)

Leakage Current . . . . . $\leq$ 30 µA
$\leq$ 60 µA (VITALERT 2000E)

Dielectric withstand . . . . . $\geq$ 1500 VAC

Chassis resistance (Chassis to AC ground terminal) . . . . . $\leq$ 0.1 OHM

Patient Leakage Current . . . . . $\leq$ 10 µA

Leads Off Sensing Current . . . . . $\leq$ 0.2 µA

Patient Isolation (AC mains to patient) . . . . . $\geq$ 4000 VAC

Battery charging time . . . . . $\leq$ 16 hours

Battery back-up time . . . . . $\geq$ 10 minutes

ECG Specifications

Sensor Input

Range . . . . . -10 to +10 mV (differential)

Resolution . . . . . 5 V (approximate)

Frequency Response . . . . . 0.05 to 100 Hz Diagnostic
0.5 to 40 Hz Monitoring

APPENDIX 1: VITALERT 2000 SPECIFICATIONS (continued)

CMRR . . . . . > 120 dB

Overall System Error . . . . . ≤ 10%

Offset Range . . . . . 500 mV

Heart Rate Measurement

Range . . . . . 30 to 250 bpm

Resolution . . . . . 1 bpm

Accuracy . . . . . ±5 bpm or ±10% of reading (whichever is greater)

Time to Alarm for Tachycardia

Time to alarm for a step change from 80 bpm (NSR) to 200 bpm (NSR) with the heart rate high alarm limit set to 100 bpm . . . . . 3 seconds

Time to alarm for a step change from 80 bpm (NSR) to 180 bpm (Ventricular) with the heart rate high alarm limit set to 100 bpm . . . . . 6 seconds

Time to alarm for a step change from 80 bpm to 120 bpm (NSR) with the heart rate high alarm limit set to 100 bpm . . . . . 3 seconds

Time to Alarm for Bradycardia

Time to alarm for a step change from 80 bpm to 0 bpm (NSR) with the heart rate low alarm limit set to 60 bpm . . . . . 3 seconds

Time to alarm for a step change from 80 bpm to 40 bpm (NSR) with the heart rate low alarm limit set to 60 bpm . . . . . 5 seconds

Heart Rate Meter Response

Time required for a complete step change from 80 bpm to 40 bpm (NSR) . . . . . 6 seconds

Time required for a complete step change from 80 bpm to 40 bpm (NSR) . . . . . 10 seconds

Tall T-Wave Rejection

Tall T-Wave rejection . . . . . exceeds 120% of R-Wave amplitude at QRS duration of 100 msec

APPENDIX 1: VITALERT 2000 SPECIFICATIONS (continued)

Invasive Blood Pressure Specifications (2 channels)

Range . . . . . 0 to 300 mm Hg

Resolution . . . . . 1 mm Hg

Sensor Sensitivity . . . . . 5 V/V/mm Hg

Frequency Response . . . . . 0 to 15 Hz

Accuracy . . . . . 5 mm Hg or 5% or reading (whichever is greater) excluding transducer error

Temperature Specifications (2 channels)

YSI 700 Series Probe

Range . . . . . 15 to 50° C (59 to 122° F)

Resolution . . . . . 0.1° C (0.1° F)

Accuracy . . . . . 0.2° C (15 to 50° C)

Serial Port Specifications

Type RS-232

Pinout:

PIN #	SIGNAL
1	DCD
2	RxD
3	TxD
4	DTR
5	GND
6	DSR
7	RTS
8	CTS
9	RI

APPENDIX 1: VITALERT 2000 SPECIFICATIONS (continued)

Baud Rate . . . . . 1200, 2400, 4800 or 9600

Parity . . . . . Odd, Even, or None

Data Bits . . . . . 7 or 8 bits/character

Stop Bits . . . . . 1 or 2

RTS/CTS . . . . . ON or OFF

Protocol . . . . . Vitalink

Environmental

Storage

Temperature . . . . . -20 to 60° C

Humidity . . . . . 10 to 90% noncondensing

Operating

Temperature . . . . . 10 to 30° C

Humidity . . . . . 10 to 90% noncondensing

APPENDIX 2: VITALERT 2000 ALARM MESSAGES

CLASS	ALARM MESSAGE	CONDITION	AUDIO	ALARM CODE	ALARM PRIORITY
W	HRT RATE LOW	Heart rate less than low limit	CONT	05H	31
C	HRT RATE HI	Heart rate greater than high limit	INT	21H	21
C	ART SYS LOW	Arterial systolic less than low limit	INT	5FH	21
C	CVP MEAN LOW	CVP mean less than low limit	INT	7DH	21
C	PA DIAS LOW	PA diastolic less than low limit	INT	7FH	21
C	P2 SYS LOW	P2 systolic less than lowlimit	INT	87H	20
C	ART SYS HI	Arterial systolic greater than high limit	INT	69H	20
C	CVP MEAN HI	CVP mean greater than high limit	INT	80H	20
C	PA DIAS HIGH	PA diastolic greater than high limit	INT	82H	20
C	P2 SYS HIGH	P2 Systolic greater than high limit	INT	88H	20
C	ECG PWR FAIL	No AC power and battery low	INT	9AH	11
A	ECG AC FAIL	AC power failure/ disconnect	SINGLE TONE	90H	7
A	ECG LL DISC	ECG left leg lead disconnect	NONE	4FH	2
A	ECG RL DISC	ECG right leg lead disconnect	NONE	8CH	2
A	ECG LA DISC	ECG left arm lead disconnect	NONE	50H	2

APPENDIX 2: VITALERT 2000 ALARM MESSAGES (continued)

CLASS	ALARM MESSAGE	CONDITION	AUDIO	ALARM CODE	ALARM PRIORITY
A	ECG RA DISC	ECG right arm lead disconnect	NONE	51H	2
A	ECG CH DISC	ECG chest lead disconnect	NONE	8DH	2
A	P1 DISC	P1 pressure lead disconnect	NONE	52H	2
A	P2 DISC	P2 pressure lead disconnect	NONE	53H	2
A	ECG CAB DISC	ECG cable or lead wire disconnect	NONE	8EH	2
A	ECG BAT LOW	Reserve power supply low	NONE	4EH	2
A	COMM ERROR	Communication error or data cable disconnect	NONE	8FH	1
A	ECG MON ERROR	ECG monitor error	NONE	66H	1
A	PAPER OUT SCR	Strip chart recorder out of paper	NONE	71H	1
A	P1 ALARM OFF	P1 alarm disabled	NONE	9CH	1
A	P2 ALARM OFF	P2 alarm disabled	NONE	9DH	1
A	HR ALARM OFF	Heart rate alarm disabled	NONE	9EH	1
A	ECG ALARM OFF	ECG alarms disabled	NONE	72H	1

APPENDIX 3: VITALERT 2000 DATA MESSAGES

DATA ID	DATA FORMAT	DATA CODE	DESCRIPTION
HEART RATE	XXX bpm	DCH	Heart rate measurement
ART SYSTOLIC	XXX mm Hg	D2H	P1 systolic measurement
ART MEAN	XXX mm Hg	CDH	P1 mean measurement
ART DIASTOLIC	XXX mm Hg	C8H	P1 diastolic measurement
CVP SYSTOLIC	XXX mm Hg	AAH	P2 CVP systolic measurement
CVP MEAN	XXX mm Hg	A5H	P2 CVP mean measurement
CVP DIASTOLIC	XXX mm Hg	A0H	P2 CVP diasolic measurement
P2 ART SYSTOLIC	XXX mm Hg	D4H	P2 ART systolic measurement
P2 ART MEAN	XXX mm Hg	D3H	P2 ART mean measurement
P2 ART DIASTOLIC	XXX mm Hg	D1H	P1 ART diastolic measurement
PA SYSTOLIC	XXX mm Hg	D9H	P2 PA systolic measurement
PA MEAN	XXX mm Hg	D8H	P2 PA mean measurement
PA DIASTOLIC	XXX mm Hg	D6H	P2 PA diastolic measurement
TEMP 1	XX.X° C	C3H	T1 temperature measurement
TEMP 2	XX.X° C	BEH	T2 temperature measurement

APPENDIX 4: TROUBLESHOOTING GUIDE

PROBLEM	POSSIBLE CAUSE	REMEDY
No ECG trace.	Cable disconnect.	Secure connections.
	Lead disconnected from electrode or cable.	
No pressure trace.	Transducer improperly attached to monitor.	Secure attachment.
	Pressure channel not zeroed.	Zero the channel.
Unable to zero pressure.	Faulty transducer.	Replace the transducer.
	Pressure offset too high.	Verify that the catheter tip is as close as possible to the same elevation as the transducer dome.
		Verify that the transducer is in the position of use and attached to the fluid system.
		Check the transducer manufacturer's instructions for use.
	Waveform greater than 5 mm Hg, peak to peak.	Check stopcocks. Prior to zeroing, be sure the pressure transducer has been positioned and connected for at least 5 minutes for stabilization.
Noisy ECG traces.	Loose or dry electrodes.	Apply new electrodes.
	Defective electrode wires.	Replace the wires.
	Patient cables or leads routed too close to other electrical devices.	Reroute other cables.
Electrosurgical interference.	Inadequate skin prep prior to electrode application.	Repeat skin prep and electrode placement procedures.
	Wrong cable type.	Replace the cable.
	Cable is damaged.	

APPENDIX 4: TROUBLESHOOTING GUIDE (continued)

PROBLEM	POSSIBLE CAUSE	REMEDY
"NOISY SIGNAL - CHECK LEADS" message on ECG display.	Electrosurgical unit is in use.	Message will go away when electrosurgical unit is not being used.
	Electrodes too close to surgery site.	Move electrodes away from surgery site.
	Wires or cable cut, cracked or otherwise damaged.	Replace wires or cable.
	Wires or cable too close to electrical noise sources such as AC power lines or other monitors.	Move wires or cable away from electrical noise source.
	Wet wires or cable.	Wipe wires or cable dry.
	Electrodes not fresh.	Replace electrodes.
	Electrodes placed over large muscles or bones.	Choose different site for electrodes.
Temperature reads low.	Poor probe/body contact.	Check body surface contact at the probe tip.
		Reposition or apply thermoconductive gel.
No display.	Unit is turned off.	Press the “ON” key on the front panel.
	Circuit breaker(s) tripped.	Check and reset.
	Unit is not plugged into a live AC outlet.	Plug the AC power cord into a live AC receptacle.
No alarm tone, heart tone, or other function.	Function has been disabled through menu selection.	Check selections made in the configuration menu.
ECG baseline with no waveform.	Scale too sensitive (set through ECG Lead key).	Readjust as required.
	Damaged cable or lead wires.	Replace damaged part.
	Baseline positioned so that waveform is off screen.	Readjust the waveform.

APPENDIX 4: TROUBLESHOOTING GUIDE (continued)

PROBLEM	POSSIBLE CAUSE	REMEDY
Baseline wander.	Static build-up around patient.	Check with Hospital Engineering Department.
	Patient moving excessively.	Secure lead wire and cable to patient.
	Artifact from patient's respiration.	Reposition electrodes.
	Dry electrodes.	Re-prep skin.
		Apply fresh electrodes.
AC noise.	Unit is in a diagnostic mode.	Select monitoring mode.
	Dry electrodes.	Re-prep the skin.
	Patient cable twisted with cable of other electrical devices.	Apply fresh electrodes.
Intermittent signal.	Loose connections (electrode to lead, lead to cable, or cable to monitor).	Secure connections.
	Dry electrodes.	Re-prep skin.
		Apply fresh electrodes.
	Damaged cable or lead wires.	Replace damaged cable or lead wire.
Excessive alarms: heart rate.	Dry electrodes.	Re-prep skin.
		Apply fresh electrodes.
	High or low alarm limit is set too close to patient's normal heart rate.	Readjust the alarm limit.
	R-wave is too small.	Select lead with a higher amplitude R-wave.
Low amplitude ECG signal on display.	Sensitivity set too low.	Readjust using SCALE key.
	Skin improperly prepared.	Re-prep skin.
	Not the patient's normal complex.	Check with a 12 lead electrocardiogram.
	Electrode positioned over a bone or muscle mass.	Reposition electrodes.

APPENDIX 4: TROUBLESHOOTING GUIDE (continued)

PROBLEM	POSSIBLE CAUSE	REMEDY
VITALERT 2000 running on battery power.	AC power cable disconnected.	Secure both ends of the AC power cable.
	Primary circuit breaker tripped.	Investigate cause and reset the breaker.
Backup battery low.	The battery was in use recently; the charge has been depleted.	Leave the VITALERT 2000 plugged into an active AC receptacle for 16 hours.
	Battery circuit breaker tripped.	Investigate cause and reset the circuit breaker.
Serial port not communicating.	Data cable disconnected.	Secure all data cables.
	VITALERT 2000 or device improperly configured.	Reconfigure port (see *Configuration* section).
Strip chart recorder not plotting.	Printer out of paper.	Insert paper into the strip chart recorder.
	No data available.	Wait for valid data.

APPENDIX 5: VITALINK COMMANDS

The Vitalert 2000 acts on the following Vitalink commands:

UPDATE REQUEST COMMANDS

Code	Command
24H	Request current data
25H	Request current low alarm limits
26H	Request current high alarm limits
27H	Request current active alarms
28H	Request current date and time

CONTROL COMMANDS

Code	Command
31H	Enable audio alarm annunciation
32H	Disable audio alarm annunciation
33H	Enable alarms
34H	Disable alarms
36H	Log data
38H	Clear trend data
39H	Invoke power-on default settings
51H	Initialize communications

CONFIGURATION COMMANDS

Code	Command
20H	Request data configuration
21H	Request low alarm limit configuration
22H	Request high alarm limit configuration
23H	Request alarm configuration

The Vitalert 2000 issues the following Vitalink commands:

UPDATE REQUEST COMMANDS

Code	Command
24H	Request current data
27H	Request current active alarms
28H	Request current time and date
29H	Request available waveform
2AH	Request current waveform data
2BH	Stop waveform

CONTROL COMMANDS

Code	Command
51H	Initialize communications

APPENDIX 6: VITALINK DATA MESSAGES

The VITALERT 2000 recognizes the following data when received via Vitalink.

DATA FORMAT	VITALINK	DATA CODE
INSP OXYGEN	XXX_%	F0H
FRESH GAS HALOTHANE	X.XX %	F1H
FRESH GAS ENFLURANE	X.XX %	F2H
FRESH GAS ISOFLURANE	X.XX %	F3H
INSP HALOTHANE	X.XX %	F4H
EXP HALOTHANE	X.XX %	F5H
INSP ENFLURANE	X.XX %	F6H
EXP ENFLURANE	X.XX %	F7H
INSP ISOFLURANE	X.XX %	F8H
EXP ISOFLURANE	X.XX %	F9H
INSP N20	XXX_%	FBH
EXP N20	XXX_%	FCH
PULSE RATE (OXIMETER)	XXX_/min	E1H
INSP CO2	XX__mm Hg	E5H
END TIDAL C02	XX__mm Hg	R6H
INSP AGENT	X.XX %	E9H
EXP AGENT	X.XX %	EAH
FRESH GAS AGENT	X.XX %	ECH
OXYGEN SATURATION	XXX_%	EBH

APPENDIX 6: VITALINK DATA MESSAGES (continued)

DATA FORMAT	VITALINK	DATA CODE
FRESH GAS N20	XXX_%	EEH
MINUTE VOLUME	XX.X L	B9H
TIDAL VOLUME	X.XX L	82H
NIBP SAMPLE AGE	XX.X min	92H
NIBP SMAPLE INTERVAL	XX.X min	94H
NIBP SYSTOLIC	XXX_mm Hg	96H
NIBP MEAN	XXX_mm Hg	91H
NIBP DIASTOLIC	XXX_mm Hg	8CH
NIBP PULSE RATE	XXX_/min	87H
MEAN BREATHING PRES	_XX_cm H_20	73H
PEEP BREATHING PRES	_XX_cm H_20	78H

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